TECHNICAL REPORT

pennsylvania
DEPARTMENT OF EDUCATION

2021–2022 CDT Technical Report

Provided by Data Recognition Corporation

This document has been formatted to be ADA compliant.

TABLE OF CONTENTS

GLOSSARY OF COMMON TERMS

The following table contains some terms used in this technical report and their meanings. Some of these terms are used universally in the assessment community, and some of these terms are used commonly by psychometric professionals.

Term	Common Definition
Ability	In Rasch scaling, *ability* is a generic term indicating the level of an individual on the construct measured by an exam. As an example, for the CDT, a student's reading ability is measured by how the student performed on the CDT Reading/Literature test.
Alternative Forms	*Alternative forms* are two or more versions of a test that are considered exchangeable; for example, they measure the same constructs in the same ways, are intended for the same purposes, and are administered using the same directions. More specific terminology applies depending on the degree of statistical similarity between the test forms (e.g., parallel forms, equivalent forms, comparable forms), where parallel forms refers to the situation in which the test forms have the highest degree of similarity to each other.
Average	*Average* is a measure of central tendency in a score distribution that usually refers to the arithmetic mean of a set of scores. In this case, it is determined by adding all the scores in a distribution and then dividing the obtained value by the total number of scores. Sometimes people use the word average to refer to other measures of central tendency such as the median (the score in the middle of a distribution) or mode (the score value with the greatest frequency).
Benchmark Activity	Also referred to as benchmarking, *benchmark activity* is a procedure used in the determination of the cut score(s) for a given assessment. It is used to measure students' progress towards certain performance standards. Methods vary (e.g., modified Angoff, Bookmark Method), but most use a panel of educators and expert judgments to operationalize the level of achievement students must demonstrate in order to be categorized within each performance level.
Benchmark Cut	A *benchmark cut* marks a specified point on a score scale where scores at or above that point are interpreted differently from scores below that point (e.g., a score designated as the minimum level of performance needed to pass a competency test). A test can be divided into multiple proficiency levels by setting one or more cut scores. Methods for establishing cut scores vary. For the CDT, one benchmark cut was set that separates students into two categories: solidly ready for the next grade or course and not solidly ready for the next grade or course.
Bias	In a statistical context, *bias* refers to any source of systematic error in the measurement of a test score. In discussing test fairness, bias may refer to construct-irrelevant components of test scores that differentially affect the performance of different groups of test takers (e.g., gender, ethnicity). Attempts are made to reduce bias by conducting item fairness reviews and various differential item functioning (DIF) analyses, detecting potential areas of concern, and either removing or revising the flagged test items prior to including them in the final operational pools (see also *Differential Item Functioning*).
Computer Adaptive Test (CAT)	A *computer adaptive test* (*CAT*) is a computer-based test with an item selection routine that adjusts (adapts) to a student's performance during the test. For this reason, it has also been called a tailored test. Rather than all students taking the same set of items (fixed form), each student's test is individually tailored with items selected from a large item pool based on the student's performance.
Constructed-Response Item	A *constructed-response item*—referred to by some as an open-ended response item—is an item format that requires examinees to create their own responses, which can be expressed in various forms. This format is in contrast to multiple-choice items, which require students to make a choice from a supplied set of answer options. There are no constructed-response items on the CDT.
Content Validity Evidence	*Content validity evidence* shows the extent to which an exam provides an appropriate sampling of a content domain of interest (e.g., assessable portions of a state's grade 6 mathematics curriculum in terms of the knowledge, skills, objectives, and processes sampled).
Criterion-Referenced Interpretation	The *criterion-referenced interpretation* is a measure of a student's performance against an expected level of mastery, educational objective, or standard. The types of resulting score interpretations provide information about what a student knows or can do in a given content area.

Term	Common Definition
Decision Consistency	*Decision consistency* is the extent to which classifications based on test scores would match the decisions on students' proficiency levels based on scores from a second parallel form of the same test. It is often expressed as the proportion of examinees who are classified the same way from the two test administrations.
Diagnostic Category	A *diagnostic category* is a grouping used for reporting results on the CDT. Each CDT test has four or five diagnostic categories which are based on the Pennsylvania Academic Standards (Mathematics, Reading, and Writing) or the Pennsylvania Academic Standards (Science).
Differential Item Functioning (DIF)	*Differential item functioning* (*DIF*) is a statistical property of a test item in which different groups of test takers (who have the same total test score) have different average item scores. In other words, students with the same ability level but different group memberships do not have the same probability of answering the item correctly (see also *Bias*).
Distractor	A *distractor* is an incorrect option in a multiple-choice item (also called a foil).
Equating	*The process that results in scores that can be used interchangeably across different test forms and/or test administrations. Equated test scores are considered exchangeable. Consequently, the requirements for equating are strong and somewhat complex (equal construct and precision, equity, and invariance). In practical terms, it is often stated that students should perceive no differences regardless of the test form administered (see also Scale Linking, Pre-equating, and Post-equating).*
Evidence-Based Selected-Response Item	A type of item that has two parts and requires the test taker to select a response from a group of possible answer choices in Part One, one of which is the correct answer (or key) to the question posed, and to then select one or two responses from a group of possible answer choices in Part Two, which provide evidence to support the correct answer in Part One.
Field-Test item	A *field-test item* is a newly developed item that is ready to be tried out to determine its statistical properties (e.g., see *p*-value and Point-Biserial Correlation). Items are field tested prior to operational administration. Items with acceptable statistical properties in field-test form the pool of CDT operational items.
Frequency	*Frequency* is the number of times that a certain value or range of values (score interval) occurs in a distribution of scores.
Frequency Distribution	*Frequency distribution* is a tabulation of scores from low to high or high to low with the number and/or percent of individuals who obtain each score or who fall within each score interval.
Infit/Outfit	*Infit* and *outfit* are statistical indicators of the agreement of the data and the measurement model. Infit and outfit are highly correlated, and they both are highly correlated with the point-biserial correlation. Underfit can be caused when low-ability students correctly answer difficult items (perhaps by guessing or atypical experience) or high-ability students incorrectly answer easy items (perhaps because of carelessness or gaps in instruction). Any model expects some level of variability, so overfit can occur when nearly all low-ability students miss an item while nearly all high-ability students get the item correct.
Item Difficulty	For the Rasch model, the dichotomous *item difficulty* represents the point along the latent trait continuum where an examinee has a 0.50 probability of making a correct response.
Key	The *key* is the correct response option or answer to a test item.
Learning Progression	A *learning progression* shows the developmental sequences or building blocks of content/skills students need to master as they progress toward career and college readiness and is tied directly to the Assessment Anchors and Eligible Content as well as the Voluntary Model Curriculum Units and Lesson Plans.
Linking	A generic term referring to a number of processes by which scores from one or more tests are made comparable to some degree. Linking includes several classes of transformations (equating, scale alignment, prediction, etc.). Equating is associated with the strongest degree of comparability (exchangeable scores). Other linkages may be very strong but fail to meet one or more of the strict criteria required of equating (see also *Equating*). CDT scores are equated.
Logit	In Rasch scaling, *logits* are units used to express both examinee ability and item difficulty. When expressing examinee ability, if two students take the same set of items, a student who answers more items correctly has a higher logit than a student who answers fewer items correctly. Logits are transformed into scale scores through a linear transformation. When expressing item difficulty, logits are transformed *p*-value (see also *P-value*). The logit difficulty scale is inversely related to *p*-values. A higher logit value would represent a relatively harder item, while a lower logit value would represent a relatively easier item.

Term	Common Definition
Mean	*Mean* is also referred to as the arithmetic mean of a set of scores. It is found by adding all the score values in a distribution and dividing by the total number of scores. For example, the mean of the set {66, 76, 85, and 97} is 81. The value of a mean can be influenced by extreme values in a score distribution.
Measure	In Rasch scaling, *measure* generally refers to a specific estimate of an examinee's ability (often expressed as logits) or an item's difficulty (again, often expressed as logits). As an example, for the CDT, a student's literature measure might be equal to 0.525 logit. Or, a CDT literature test item might have a logit equal to -0.905.
Median	The *median* is the middle point or score in a set of rank-ordered observations that divides the distribution into two equal parts; each part contains 50 percent of the total data set. More simply put, half of the scores are below the median value and half of the scores are above the median value. As an example, the median for the following ranked set of scores {2, 3, 6, 8, 9} is 6.
Multiple-Choice Item	A *multiple-choice item* is a type of item format that requires the test taker to select a response from a group of possible choices, one of which is the correct answer (or key) to the question posed. All items on the CDT are multiple-choice items.
N-count	Sometimes designated as *N* or *n*, it is the number of observations (usually individuals or students) in a particular group. Some examples include the number of students tested, the number of students tested from a specific subpopulation (e.g., females), and the number of students who attained a specific score. In the following set {23, 32, 56, 65, 78, 87}, $n = 6$.
Operational Item	After initial item tryout (field test), all items with acceptable statistical properties form the pool of CDT *operational items*. Students' tests are selected from this pool.
Percent Correct	When referring to an individual item, the *percent correct* is the item's *p*-value from the field test administration expressed as a percent (instead of a proportion). Under a computer adaptive administration, percent correct scores are not appropriate for individual items or students.
Percentile	*Percentile* is the score or point in a score distribution at or below which a given percentage of scores fall. It should be emphasized that it is a value on the score scale, not the associated percentage (although sometimes in casual usage this misinterpretation is made). For example, if 72 percent of the students score at or below a scale score of 1500 on a given test, then the scale score of 1500 would be considered the 72nd percentile. As another example, the median is the 50th percentile.
Percentile Rank	The *percentile rank* is the percentage of scores in a specified distribution that fall at/below a certain point on a score distribution. Percentile ranks range in value from 1 to 99. They indicate the status or relative standing of an individual within a specified group by indicating the percent of individuals in that group who obtained equal or lower scores. An individual's percentile rank can vary depending on which group is used to determine the ranking. As suggested above, percentiles and percentile ranks are sometimes used interchangeably; however, strictly speaking, a percentile is a value on the score scale.
Point-Biserial Correlation	In classical test theory, *point-biserial correlation* is an item discrimination index. It is the correlation between a dichotomously scored item and a continuous criterion, usually represented by the total test score (or the corrected total test score with the reference item removed). It reflects the extent to which an item differentiates between high-scoring and low-scoring examinees. This discrimination index ranges from –1.00 to +1.00. The higher the discrimination index (the closer to +1.00), the better the item is considered to be performing. For multiple-choice items scored as 0 or 1, it is rare for the value of this index to exceed 0.5.
Post-Equating	Post-equating refers to the method of utilizing data from the current administration for scale linking and equating. Post-equating relies heavily on collecting data from a representative sample, estimating new item parameters, linking the item parameters to the base sale, and estimating student ability based on the linked item parameters. In order to provide immediate results, CDT utilizes pre-equating. Post-equating is conducted for field-test analyses and updating item parameters.
Pre-Equating	Pre-equating refers to the method of utilizing previously estimated and linked item parameters for equating. Because item parameters have already been linked to the base scale, pre-equated solutions are available immediately after a CDT is completed.

Term	Common Definition
P-value	A *p-value* is an index indicating an item's difficulty for some specified group (perhaps grade). It is calculated as the proportion (sometimes percent) of students in the group who answer an item correctly. *P*-values range from 0.0 to 1.0 on the proportion scale. Lower values correspond to more difficult items and higher values correspond to easier items. *P*-values are usually provided for multiple-choice items or other items worth one point. For open-ended items or items worth more than one point, difficulty on a *p*-value-like scale can be estimated by dividing the item mean score by the maximum number of points possible for the item (see also *Logit*).
Raw Score	*Raw score* is an unadjusted score usually determined by tallying the number of questions answered correctly or by the sum of item scores (i.e., points). Raw scores typically have little or no meaning by themselves and require additional information like the number of items on the test and the difficulty of the test items. Under a computer adaptive administration, where each student takes a unique set of items, raw scores are not comparable across students.
Reliability	*Reliability* is the expected degree to which test scores for a group of examinees are consistent over exchangeable replications of an assessment procedure and, therefore, considered dependable and repeatable for an individual examinee. A test that produces highly consistent, stable results (i.e., relatively free from random error) is said to be highly reliable. The reliability of a test is typically expressed as a reliability coefficient or by the standard error of measurement derived by that coefficient.
Reliability Coefficient	*Reliability coefficient* is a statistical index that reflects the degree to which scores are free from random measurement error. Theoretically, it expresses the consistency of test scores as the ratio of true score variance to total score variance (true score variance plus error variance). This statistic is often expressed as a correlation coefficient (e.g., correlation between two forms of a test) or with an index that resembles a correlation coefficient (e.g., calculation of a test's internal consistency using coefficient alpha). Expressed this way, the reliability coefficient is a "unitless" index. The higher the value of the index (closer to 1.0), the greater the reliability of the test (see also *Standard Error of Measurement*).
Scale Linking	*The first step in any equating process in which independent item estimates are placed on the same scale of measurement (the logit scale). Scale linking results in item parameters that are on the same scale of measurement. Equating procedures can only be implemented once scale linking is achieved (see also Equating).*
Scale Score	*Scale score* is a mathematical transformation of a Rasch ability estimate developed through a process called scaling. Scale scores are most useful when comparing test results over time. Several different methods of scaling exist, but each is intended to provide a continuous and meaningful score scale across different forms of a test.
Standard Deviation	*Standard deviation* is a statistic that measures the degree of spread or dispersion of a set of scores. The value of this statistic is always greater than or equal to zero. If all of the scores in a distribution are identical, the standard deviation is equal to zero. The further the scores are away from one another in value, the greater the standard deviation. This statistic is calculated using the information about the deviations (distances) between each score and the distribution's mean. It is equivalent to the square root of the variance statistic. The standard deviation is a commonly used method of examining a distribution's variability since the standard deviation is expressed in the same units as the data.
Standard Error of Measurement (SEM)	*Standard error of measurement* (*SEM*) is the amount an observed score is expected to fluctuate around the true score. As an example, across replications of a measurement procedure, the true score will not differ by more than plus or minus one standard error from the observed score about 68 percent of the time (assuming normally distributed errors). The SEM is frequently used to obtain an idea of the consistency of a person's score in actual score units, or to set a confidence band around a score in terms of the error of measurement. Often a single SEM value is calculated for all test scores. On other occasions, however, the value of the SEM can vary along a score scale. Conditional standard error of measurement (CSEM) also indicates the degree of measurement error in scale score units but varies as a function of a student's unique set of items and actual scale score.
Step Difficulty	*Step difficulty* is a parameter estimate in Master's Partial Credit Model (PCM) that represents the relative difficulty of each score step (e.g., going from a score of 1 to a score of 2). The higher the value of a particular step difficulty, the more difficult a particular step is relative to other score steps (e.g., is it harder to go from a 1 to a 2, or to go from a 2 to a 3).

Term	Common Definition
Technical Advisory Committee (TAC)	The *technical advisory committee* (*TAC*) is a group of individuals (most often professionals in the field of testing) that are either appointed or selected to make recommendations for and to guide the technical development of a given testing program.
Technology Enhanced (TE) Items	*Technology Enhanced (TE)* items are items that capitalize on computer-based interactions for collecting response data. Examples of TE items include drop-down menus, drag and drop functionality, text highlighting, and other interactions.
Validity	*Validity* is the degree to which accumulated evidence and theory support specific interpretations of test scores entailed by the purpose of a test. There are various ways of gathering validity evidence.

PREFACE: AN OVERVIEW OF THE CDT

CLASSROOM DIAGNOSTIC TOOLS (CDT) OVERVIEW

The Pennsylvania Classroom Diagnostic Tools (CDT) is a set of online assessments, divided by content area, designed to provide diagnostic information in order to guide instruction and intervention. The CDT reporting system is fully integrated in Pennsylvania's Standards Aligned System (SAS). It assists educators in identifying student academic strengths and areas in need of improvement by providing links to classroom resources. The diagnostic reports feature easy-to-follow links to targeted curricular resources and materials, including units and lesson plans found within the SAS system. Students in grades 3 through high school at all Pennsylvania schools may take the CDT up to five times throughout the school year at no cost.

The purpose of the CDT is to provide information that will help guide instruction by providing support to students and teachers. The CDT reports are designed to provide a picture or snapshot of how students are performing in relation to the Pennsylvania Assessment Anchors and Eligible Content and Keystone Assessment Anchors and Eligible Content. The CDT goes beyond focusing only on **What** students should know and be able to do at a particular grade and/or course. It also provides a snapshot of **How** and **Why** students may still be struggling or extending beyond the grade and/or course Eligible Content. This valuable information is typically not identified through other types of assessments. Teachers, through the use of the CDT reports, may access additional information through the Learning Progression Map. The Learning Progression Map allows teachers to pinpoint where students are struggling or where they are extending beyond the learning continuum. The CDT helps identify and provides suggestions for next steps in student academic development.

The CDT consists of only multiple-choice questions and evidence-based selected response questions. The questions were developed to specifically align to the Pennsylvania Assessment Anchors and Eligible Content at kindergarten through high school and the Keystone Assessment Anchors and Eligible Content for end-of-course. The CDT is based on content assessed by the Pennsylvania System of School Assessments (PSSA) and the Keystone Exams. It includes interactive and dynamic reporting for various diagnostic reporting categories.

CDT Activities for the 2021–2022 School Year

Description	Date
Test Setup System Available	August 9, 2021
First Day of Testing	August 16, 2021
Last Day of Testing	June 17, 2022

CHAPTER ONE: BACKGROUND OF THE CLASSROOM DIAGNOSTIC TOOLS

This brief overview of the Pennsylvania Classroom Diagnostic Tools summarizes the program's intent and purpose, as well as key dates in the development process.

THE CLASSROOM DIAGNOSTIC TOOLS

The Classroom Diagnostic Tools (CDT) is a set of online assessments, divided by content area, designed to provide diagnostic information in order to a guide instruction and enrichment. The CDT reporting system is fully integrated in the Standards Aligned System (SAS). It assists educators in identifying student academic strengths and areas in need of improvement by providing links to classroom resources. The diagnostic reports feature easy-to-follow links to targeted curricular resources and materials, including units and lesson plans found within the SAS system. The CDT is available to districts at no cost.

The CDT is:

- Offered to students in grades 3 through high school
- Available for use in the classroom throughout the school year on a voluntary basis
- Based on content assessed by the Keystone Exams and the Pennsylvania System of School Assessment (PSSA)
- Comprised of multiple-choice items (all content areas), and evidence-based selected-response items (in Reading and Literature only)
- Delivered as an online Computer Adaptive Test (CAT), ensuring valid and reliable measures of a student's skills while minimizing testing time
- Designed to provide real-time results for students and teachers with links to Materials and Resources in SAS
- Available for Mathematics Lower Grades[1], Mathematics, Algebra I, Geometry, Algebra II, Reading Lower Grades, Reading/Literature, Science Lower Grades, Science, Biology, Chemistry, Writing Lower Grades, and Writing/English Composition
- Available as Full CDT, which covers multiple diagnostic categories, or as Diagnostic Category CDT, which covers a single category.

KEY DATES

The items for each course of the CDT were field tested online using fixed-form computer-based tests prior to their use in operational computer adaptive tests. Additional items were field tested as items embedded within the operational CDT to increase the pool of items aligned to the Pennsylvania Core Standards and to allow the extension of the CDT to students in grades 3 through 5. The timeline for implementation of the field tests and operational availability is shown in the following table.

[1] CDTs with the "Lower Grades" designation are for students in grades 3 through 5.

Table 1–1. Key Dates

Course	Field Test Dates	Operational Rollout Dates
Mathematics, Algebra I, Geometry, Algebra II	Spring 2010	Fall 2010
Reading/Literature	Fall 2010	Spring 2011
Science, Biology, Chemistry	Fall 2010	Spring 2011
Writing/English Composition	Spring 2011	Fall 2011
Mathematics, Reading/Literature, and Writing/English Composition aligned to the Pennsylvania Core Standards[2]	Spring 2013	Fall 2013
Mathematics Lower Grades, Reading Lower Grades, Science Lower Grades, and Writing Lower Grades	Fall 2013	Spring 2014
Mathematics, Algebra I, Algebra II, Reading, Literature, Writing, English Composition, Science, Biology, and Chemistry	Fall 2018	Fall 2019
Science and Biology	Spring 2019	Spring 2020
Mathematics, Algebra I, Algebra II, Reading, Literature, Writing, English Composition, Science, Biology, and Chemistry	Summer 2022	Summer 2023

For more details on field-test events, see Chapter Six.[2]

[2] The alignment of Mathematics, Reading/Literature, and Writing/English Composition to the Pennsylvania Core Standards did not include field-test items for Writing/English Composition, as the Writing/English Composition pool did not require additional items to be fully aligned to the Pennsylvania Core Standards.

CHAPTER TWO: TEST DEVELOPMENT OVERVIEW OF THE PENNSYLVANIA CDT FRAMEWORK

The Pennsylvania Classroom Diagnostic Tools (CDT) is available for Mathematics Lower Grades, Mathematics, Algebra I, Geometry, Algebra II, Reading Lower Grades, Reading/Literature, Science Lower Grades, Science, Biology, Chemistry, Writing Lower Grades, and Writing/English Composition for students in grades 3 through high school. The assessments are administered online in a computer adaptive test (CAT) format.

The Pennsylvania CDT consists of multiple-choice, evidence-based selected-response, and technology-enhanced, questions that align to the Pennsylvania Assessment Anchors and Eligible Content at grades 3 through high school for mathematics, reading, writing, and science and the Keystone Assessment Anchors and Eligible Content for end-of-course for Algebra I, Algebra II, Geometry, Literature, English Composition, Biology, and Chemistry and evidence-based selected-response questions that align to the Pennsylvania Assessment Anchors and Eligible Content at grade 3 through 8 for reading. With the exception of grades 3, 5, 6, and 7 for Science, these Pennsylvania Assessment Anchors and Eligible Content were developed previously for the PSSA and Keystone Exams as described in the following sections. In addition, Learning Progressions were developed to show the pathways along which students travel as they progress towards mastery of the skills in each content area.

BACKGROUND FOR THE PSSA ASSESSMENT ANCHORS AND ELIGIBLE CONTENT

The PSSA Assessment Anchor Content Standards and Eligible Content in Mathematics, Reading, and Writing are based on the Pennsylvania Core Standards. The PSSA Assessment Anchor Content Standards and Eligible Content in Science are based on the Pennsylvania Academic Standards. Although the Pennsylvania Core Standards and the Pennsylvania Academic Standards indicate what students should know and be able to do, educator concerns regarding the number and breadth of Academic Standards led to an initiative by the Pennsylvania Department of Education (PDE) to develop Assessment Anchor Content Standards (Assessment Anchors) to indicate which parts of the Academic Standards (Instructional Standards) would be assessed on the PSSA. Based on recommendations from Pennsylvania educators, the Assessment Anchors were designed as a tool to improve the articulation of curricular, instructional, and assessment practices. The Assessment Anchors clarify what is expected across each grade span and focus the content of the standards into what is assessable on a large-scale test. The Assessment Anchor documents also serve to communicate Eligible Content, also called assessment limits, or the range of knowledge and skills from which the PSSA would be designed.

The Assessment Anchor's coding is read like an outline. The coding includes the content, grade level, Reporting Category, Assessment Anchor, descriptor (Sub-Assessment Anchor), and Eligible Content. Thus, S.4.A.1.3.1 would be Science, Grade 4, Reporting Category A, Assessment Anchor 1, descriptor (Sub-Assessment Anchor) 3, and Eligible Content 1.

Each of the Assessment Anchors has one or more descriptors (Sub-Assessment Anchors) and Eligible Content varying to reflect grade-level appropriateness. The Assessment Anchors form the basis of the test design for the grades undergoing new test development. In turn, this hierarchy is the basis for organizing the total content scores (based on the core [common] sections).

With Pennsylvania's decision to adopt the Pennsylvania Core Standards based on the Common Core State Standards, committees of Pennsylvania educators met in October 2011 to write, review, and approve the Assessment Anchors and Eligible Content statements. To provide initial focus, each content and grade span committee was presented with materials specific to the content and grade span in question, including a basic blueprint structure, the Pennsylvania Academic Standards, the Pennsylvania Assessment Anchors and Eligible Content aligned to the Pennsylvania Academic Standards, the Common Core State Standards, and draft Eligible Content statements. Committees then completed an iterative process of reviewing and revising the draft Eligible Content statements followed by discussions across grade-span committees to ensure vertical articulation across the grades. The results from the committee work were evaluated by national, state, and local subject matter experts, and, following revisions, they were ultimately validated by another committee of Pennsylvania educators. Following committee approval, the Pennsylvania Core Standards-aligned Assessment Anchors and Eligible Content for English Language Arts and Mathematics were approved by the State Board of Education in September 2013.

The complete set of Assessment Anchors and Eligible Content can be referenced at PDE's website: www.education.pa.gov.

- Roll over `Data and Reporting' in the bar across the top of the page.
- Select `Assessment and Accountability.' Click on the link that reads `PSSA - PA System of School Assessment'. Then click on Assessment Anchors/Eligible Content

For Science, Assessment Anchors and Eligible Content had only been previously developed at grades 4, 8, and 11 for the PSSA and for the Biology and Chemistry Keystone Exams. Therefore, to provide a vertical articulation of science content from grade to grade, a group of Pennsylvania educators were brought together to develop Assessment Anchors and Eligible Content for the off grades (those that do not assess Science on the PSSA). These educators, in collaboration with DRC Science Test Development staff, used the Assessment Anchors and Eligible Content for grades 4, 8, and 11 as the foundation to develop Assessment Anchors and Eligible Content for grades 3, 5, 6, and 7.

With the extension of the CDT to allow students in grades 3 through 5 to participate in the assessments, it was necessary to include items appropriate to assess skills and understandings that students should learn in kindergarten through grade 2. For Mathematics, Reading, and Writing, test questions were developed based to align to the Pennsylvania Core Standards for grades K through 2. For Science, a group of Pennsylvania educators was brought together in March 2013 to develop the Science Grades K-2 Assessment Anchors and Eligible Content, which are organized as a single grade band and contain foundational science concepts in order to promote flexibility in classroom instruction for these early grade levels.

BACKGROUND FOR THE KEYSTONE ASSESSMENT ANCHORS AND ELIGIBLE CONTENT

The Keystone Test Blueprints—known as the Keystone Assessment Anchors and Eligible Content—are based on Pennsylvania Keystone Course Standards and the Common Core State Standards. Prior to the development of the Assessment Anchors, multiple groups of Pennsylvania educators convened to create a set of standards for each of the Keystone Exams. Derived from a review of existing standards, these Enhanced Standards (Course Standards) focus on what students need to know and be able to do in order to be college and career ready.

Although the Keystone Course Standards indicate what students should know and be able to do, Assessment Anchors are designed to indicate which parts of the Keystone Course Standards (Instructional Standards) will be assessed on the Keystone Exams. Based on recommendations from Pennsylvania educators, the Assessment Anchors were designed as a tool to improve the articulation of curricular, instructional, and assessment practices. The Assessment Anchors clarify what is expected and focus the content of the standards into what is assessable on a large-scale exam. The Assessment Anchor documents also serve to communicate Eligible Content, or the range of knowledge and skills from which the Keystone Exams are designed.

The Keystone Assessment Anchors and Eligible Content have been designed to hold together or *anchor* the state assessment system and curriculum/instructional practices in schools following these design parameters:

- **Clear:** The Assessment Anchors are easy to read and are user-friendly; they clearly detail which standards are assessed on the Keystone Exams.
- **Focused:** The Assessment Anchors identify a core set of standards that could be reasonably assessed on a large-scale assessment, which will keep educators from having to guess which standards are critical.
- **Rigorous:** The Assessment Anchors support the rigor of the state standards by assessing higher order and reasoning skills.
- **Manageable**: The Assessment Anchors define the standards in a way that can be easily incorporated into a course to prepare students for success.

The Assessment Anchors and Eligible Content are organized into cohesive blueprints, each structured with a common labeling system. This framework is organized first by Module (Reporting Category), then by Assessment Anchor, followed by Anchor Descriptor, and then finally, at the greatest level of detail, by an Eligible Content statement. The common format of this outline is followed across the Keystone Exams.

Here is a description of each level in the labeling system for the Keystone Exams.

- **Module:** The Assessment Anchors are organized into two thematic modules for each of the Keystone Exams, and these modules serve as the Reporting Categories for the Keystone Exams. The Module title appears at the top of each page in the Assessment Anchor document. The Module level is also important because the Keystone Exams are built using a Module format, with each of the Keystone Exams divided into two equally sized test modules. Each Module is made up of two or more Assessment Anchors.
- **Assessment Anchor:** The Assessment Anchor appears in the shaded bar across the top of each Assessment Anchor table in the Assessment Anchor document. The Assessment Anchors represent categories of subject matter that anchor the content of the Keystone Exams. Each Assessment Anchor is part of a Module and has one or more Anchor Descriptors unified under it.
- **Anchor Descriptor:** Below each Assessment Anchor in the Assessment Anchor document is a specific Anchor Descriptor. The Anchor Descriptor level provides further details that delineate the scope of content covered by the Assessment Anchor. Each Anchor Descriptor is part of an Assessment Anchor and has one or more Eligible Content statements unified under it.
- **Eligible Content:** The column to the right of the Anchor Descriptor in the Assessment Anchor document contains the Eligible Content statements. The Eligible Content is the most specific description of the content that is assessed on the Keystone Exams. This level is considered the assessment limit and helps educators identify the range of content covered on the Keystone Exams.
- **Enhanced Standard:** In the column to the right of each Eligible Content statement is a code representing one or more Enhanced Standards that correlate to the Eligible Content statement. Some Eligible Content statements include annotations that indicate certain clarifications about the scope of an Eligible Content.
- **Notes:** There are three types of notes included in the Assessment Anchor document:
"e.g." ("for example")—sample approach, but not a limit to the Eligible Content
"i.e." ("that is")—specific limit to the Eligible Content
"Note"—content exclusions or definable range of the Eligible Content

The Assessment Anchor's coding is read like an outline. The coding includes the Subject (Exam), Reporting Category/Module, Assessment Anchor, Anchor Descriptor, and Eligible Content. Each exam has two modules. Each Module has two or more Assessment Anchors. Each of the Assessment Anchors has one or more Anchor Descriptors, and each Anchor Descriptor has at least one Eligible Content statements (generally more than one). The Assessment Anchors form the basis of the test design for the exams undergoing test development. In turn, this hierarchy is the basis for organizing the total Module and exam scores.

Table 2–1. Sample Keystone Assessment Anchor Coding

Sample Code	Subject (Exam)	Reporting Category (Module)	Assessment Anchor (AA)	Anchor Descriptor (AD)	Eligible Content (EC)
A1.1.1.2.1	A1–Algebra I	1 – Operations and Linear Equations & Inequalities	1 – Linear Equations	2 – Write, solve, and/or graph linear equations using various methods.	1 – Write, solve, and/or apply a linear equation (including problem situations).
BIO.A.2.1.1	BIO –Biology	A – Cells and Cell Processes	2 – The Chemical Basis for Life	1 – Describe how the unique properties of water support life on Earth.	1 – Describe the unique properties of water and how these properties support life on Earth (e.g., freezing point, high specific heat, cohesion).
L.F.2.4.1	L –Literature	F – Fiction	2 – Analyzing and Interpreting Literature—Fiction	4 – Use appropriate strategies to interpret and analyze the universal significance of literary fiction.	1 – Interpret and analyze works from a variety of genres for literary, historical, and/or cultural significance.

The complete set of Assessment Anchors and Eligible Content can be referenced at *PDE's Standards Aligned System (SAS) website* at http://www.pdesas.org/Standard. Assessment Anchors and Eligible Content for Grades 3–8 can be found by selecting "Download PSSA and PASA Anchors and Eligible Content" while Assessment Anchors and Eligible Content for high school courses can be found by selecting "Download Keystone Anchors."

DIAGNOSTIC CATEGORIES FOR THE CLASSROOM DIAGNOSTIC TOOLS

The Classroom Diagnostic Tools provide information for teachers, students, and other stakeholders regarding student performance at the Overall Score level and also for each diagnostic category within the selected assessment. These diagnostic categories provide more detailed information about student strengths and areas of need for a related group of Eligible Content. A description of the diagnostic categories for each assessment follows.

MATHEMATICS LOWER GRADES AND MATHEMATICS

There are four diagnostic categories for the mathematics assessments. These are *Numbers & Operations*, *Algebraic Concepts*, *Geometry*, and *Measurement, Data, and Probability*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the table below.

Table 2–2. Number of Eligible Content per Diagnostic Category by Grade for Mathematics Lower Grades and Mathematics

Diagnostic Category	Kindergarten*	Grade 1*	Grade 2*	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Numbers & Operations	1	3	3	9	20	13	15	9	5	6
Algebraic Concepts	1	2	3	14	8	4	11	5	17	46
Geometry	2	2	2	3	3	3	6	8	8	29
Measurement, Data, and Probability	2	3	5	15	9	5	4	7	4	12

* Eligible Content for Kindergarten, Grade 1, and Grade 2 are not included in the Mathematics CDT.

ALGEBRA I

The Keystone Algebra I Assessment Anchors and Eligible Content has two reporting categories: Module 1, Operations and Linear Equations & Inequalities, and Module 2, Linear Functions and Data Organizations. These modules are each divided into two diagnostic categories. Module 1 is divided into *Operations with Real Numbers and Expressions* and *Linear Equations & Inequalities*. Module 2 is divided into *Functions & Coordinate Geometry* and *Data Analysis*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the following table.

Table 2–3. Number of Eligible Content per Diagnostic Category by Grade for Algebra I

Diagnostic Category	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Module 1 – Operations with Real Numbers and Expressions	13	11	5	17	10	7	18
Module 1 – Linear Equations & Inequalities	0	0	0	3	3	8	16
Module 2 – Functions & Coordinate Geometry	0	3	1	4	1	10	21
Module 2 – Data Analysis	3	0	1	4	7	4	11

GEOMETRY

The Keystone Geometry Assessment Anchors and Eligible Content has two reporting categories: Module 1, Geometric Properties & Reasoning, and Module 2, Coordinate Geometry & Measurement. These modules are each divided into two diagnostic categories. Module 1 is divided into *Geometric Properties* and *Congruence, Similarity, & Proofs*. Module 2 is divided into *Coordinate Geometry & Right Triangles* and *Measurement*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the following table.

Table 2–4. Number of Eligible Content per Diagnostic Category by Grade for Geometry

Diagnostic Category	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Module 1 – Geometric Properties	2	2	1	1	5	1	18
Module 1 – Congruence, Similarity, & Proofs	0	1	0	0	0	2	3
Module 2 – Coordinate Geometry & Right Triangles	0	0	1	3	1	7	5
Module 2 – Measurement	6	4	2	4	3	0	13

ALGEBRA II

The Keystone Algebra II Assessment Anchors and Eligible Content has two reporting categories: Module 1, Number Systems and Non-Linear Expressions & Equations, and Module 2, Functions and Data Analysis. These modules are each divided into two diagnostic categories. Module 1 is divided into *Operations with Complex Numbers* and *Non-Linear Expressions & Equations*. Module 2 is divided into *Functions* and *Data Analysis*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the following table.

Table 2–5. Number of Eligible Content per Diagnostic Category by Grade for Algebra II

Diagnostic Category	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Module 1 – Operations with Complex Numbers	0	0	0	0	0	0	4
Module 1 – Non-Linear Expressions & Equations	0	1	1	16	9	8	30
Module 2 – Functions	0	3	0	1	0	5	20
Module 2 – Data Analysis	3	0	1	4	7	3	11

SCIENCE LOWER GRADES AND SCIENCE

There are four diagnostic categories for the science assessments. These are *The Nature of Science*, *Biological Sciences*, *Physical Sciences*, and *Earth/Space Sciences*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the table below.

Table 2–6. Number of Eligible Content per Diagnostic Category by Grade for Science Lower Grades and Science

Diagnostic Category	K–2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
The Nature of Science	7	9	20	8	10	19	31	27
Biological Sciences	7	14	18	11	7	21	21	38
Physical Sciences	1	10	9	12	12	12	12	46
Earth/Space Sciences	8	13	16	8	7	11	13	14

BIOLOGY

The Keystone Biology Exam has two reporting categories: Module 1[A], Cells and Cell Processes, and Module 2[B], Continuity and Unity of Life. These modules are each divided into two diagnostic categories. Module 1 is divided into *Basic Biological Principles/Chemical Basis for Life* and *Bioenergetics/Homeostasis & Transport*. Module 2 is divided into *Cell Growth & Reproduction/Genetics* and *Theory of Evolution/Ecology*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the following table.

Table 2–7. Number of Eligible Content per Diagnostic Category by Grade for Biology

Diagnostic Category	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Module 1 – Basic Biological Principles/Chemical Basis for Life	5	5	3	3	5	5	9
Module 1 – Bioenergetics/Homeostasis & Transport	0	0	0	0	0	0	7
Module 2 – Cell Growth & Reproduction/Genetics	2	1	1	0	5	4	10
Module 2 – Theory of Evolution/Ecology	8	13	5	3	18	18	12

CHEMISTRY

The Keystone Chemistry Assessment Anchors and Eligible Content has two reporting categories: Module 1[A], Structure and Properties of Matter, and Module 2[B], The Mole Concept and Chemical Interactions. These modules are each divided into two diagnostic categories. Module 1 is divided into *Properties & Classification of Matter* and *Atomic Structure & the Periodic Table*. Module 2 is divided into *The Mole & Chemical Bonding* and *Chemical Relationships & Reactions*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the following table.

Table 2–8. Number of Eligible Content per Diagnostic Category by Grade for Chemistry

Diagnostic Category	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Module 1 – Properties & Classification of Matter	7	4	7	7	3	3	10
Module 1 – Atomic Structure & The Periodic Table	0	0	0	0	1	0	8
Module 1 – The Mole & Chemical Bonding	0	0	0	0	1	1	9
Module 2 – Chemical Relationships & Reactions	0	0	1	0	1	1	7

READING LOWER GRADES AND READING/LITERATURE

The Reading Lower Grades and Reading/Literature Assessments use the same diagnostic categories across grades 3 through 8 and the high school Literature course. These diagnostic categories are not divided across the two Keystone Literature Modules (reporting categories) of Fiction and Non-fiction. The diagnostic categories for Reading Lower Grades and Reading/Literature are *Key Ideas and Details – Literature Text; Key Ideas and Details – Informational Text; Craft and Structure/Integration of Knowledge and Ideas – Literature Text; Craft and Structure/Integration of Knowledge and Ideas – Informational Text;* and *Vocabulary Acquisition and Use*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the following table.

Table 2–9. Number of Eligible Content per Diagnostic Category by Grade for Reading Lower Grades and Reading/Literature

Diagnostic Category	Kindergarten*	Grade 1*	Grade 2*	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Key Ideas and Details—Literature Text	3	3	3	3	3	3	3	3	3	8
Key Ideas and Details—Informational Text	3	3	3	3	3	3	3	3	3	12
Craft and Structure/ Integration of Knowledge and Ideas—Literature Text	2	2	2	2	2	2	4	4	4	14
Craft and Structure/ Integration of Knowledge and Ideas—Informational Text	4	4	4	5	5	5	5	5	5	18
Vocabulary Acquisition and Use	2	2	2	4	4	4	4	4	4	6

* Eligible Content for Kindergarten, Grade 1, and Grade 2 are not included in the Reading/Literature CDT.

WRITING LOWER GRADES AND WRITING/ENGLISH COMPOSITION

The Writing Lower Grades and Writing/English Composition Assessments use the same diagnostic categories across grades 3 through 8 and the high school English Composition course. The diagnostic categories for Writing Lower Grades and Writing/English Composition are *Quality of Writing: Focus and Organization*, *Quality of Writing: Content and Style*, *Quality of Writing: Editing*, *Conventions: Punctuation, Capitalization, and Spelling*, and *Conventions: Grammar and Sentence Formation*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the following table.

Table 2–10. Number of Eligible Content per Diagnostic Category by Grade for Writing Lower Grades and Writing/English Composition

Diagnostic Category	Kindergarten*	Grade 1*	Grade 2*	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Quality of Writing: Focus and Organization	3	6	6	6	6	6	6	6	6	4
Quality of Writing: Content and Style	2	3	3	3	3	5	5	5	5	4
Quality of Writing: Editing	0	3	3	4	10	12	11	10	6	13
Conventions: Punctuation, Capitalization, and Spelling	1	3	2	6	4	5	3	3	3	5
Conventions: Grammar and Sentence Formation	2	3	2	10	9	9	9	7	5	2

* Eligible Content for Kindergarten, Grade 1, and Grade 2 are **not** included in the Writing/English Composition CDT.

CHAPTER THREE: GENERAL CLASSROOM DIAGNOSTIC TOOLS TEST DEVELOPMENT PROCESSES

The operational item pool for each Classroom Diagnostic Tool (CDT) subject is made up of multiple-choice items that were field tested in a stand-alone field test administration in addition to a smaller number of multiple choice, evidence-based selected-response (Reading only), and technology-enhanced (Science only) items embedded later in operational assessments. Due to the large number of items needed for each CDT Computer Adaptive Test (CAT) to provide reliable information about student strengths and areas of need, it was decided to stagger the content areas for both development and field testing. Appendix A shows a graphic representation of the basic process flow and overlap of the development cycles.

Mathematics (comprising Mathematics, Algebra I, Algebra II, and Geometry) was developed first. After initial development and internal reviews by DRC, the items were taken to be reviewed by Pennsylvania educators. Upon completion of the educator reviews, edits were incorporated, and items were placed into online field-test fixed-forms for a stand-alone, voluntary field test. For more information regarding the field test, see Chapter Six. After the field test, item statistics were reviewed, and those items that had questionable data were taken to an item data review with Pennsylvania educators. See Chapter Six for more information about this meeting. Following the item data review, all items administered during the field test were reviewed by a committee of Pennsylvania educators for alignment to the Learning Progression Maps. More information about this meeting is found later in this chapter. After the alignment review, committees of Pennsylvania educators participated in a benchmarking activity to determine the points on the scale at which students in each of grades 5 through high school could be considered solidly ready for the next course. For more information about the benchmarking process, see Chapter Ten. Following this set of meetings, the statuses of items were updated, and accepted items were included in the item pool for the operational administrations.

This same process was then repeated for Literature (comprising Reading and Literature) and for Science (comprising Science, Biology, and Chemistry), and then finally for Writing (comprising Writing and English Composition). See Appendix A for more information about the basic development cycles for these three subjects.

Additional items in Mathematics and Reading/Literature were developed for an embedded field test in spring 2013. The purpose of this development was to supplement the pool with additional items aligned to the Pennsylvania Core Standards in preparation for the transition to align all Mathematics and Literacy (Reading/Literature and Writing/English Composition) assessments with the Pennsylvania Core Standards. Following the field test, the items that had questionable data were taken to an item data review with Pennsylvania educators (more information about this meeting can be found in Chapter Six). Following the item data review, all items administered during the field test were reviewed by a committee of Pennsylvania educators for alignment to the Learning Progression Maps using the same procedure that was used for the initial development of each pool of items.

In fall 2013, a voluntary stand-alone field test was conducted for items aligned to the Mathematics and English Language Arts (Reading and Writing) Pennsylvania Core Standards in kindergarten through grade 2, the K–2 Science Assessment Anchors and Eligible Content, and the Mathematics, English Language Arts, and Science Assessment Anchors and Eligible Content for grades 3 and 4. These were administered to students in grades 3 through 5, as described in Chapter Six. At the same time, items developed to align to the Mathematics, English Language Arts, and Science Assessment Anchors and Eligible Content for grade 5 were administered as part of an embedded field test to students in grade 6 that completed an operational CDT administration. The purpose of these two field test administrations was to provide enough items to allow students in grades 3 through 5 to be included in the CDT assessments. The Mathematics Lower Grades, Reading Lower Grades, Science Lower Grades, and Writing Lower Grades assessments became available in spring 2014.

Additional items were developed in 2015 for an embedded field test in 2016. The purpose of this development was to supplement the pool with additional items including Evidence Based Selected Response (EBSR) items aligned to the Pennsylvania Core Standards for the reading/literature CDT. These EBSR items were developed to align to the English Language Arts Assessment Anchors and Eligible Content for grades 3 through 8 and were administered as part of an embedded field test to students that completed an operational CDT administration. Additional multiple-choice items were also field tested in mathematics and science.

An additional set of items in were developed in 2018 for an embedded field test in 2018. The purpose of this development was to supplement the pool with additional items in mathematics, English language arts and science. These items were aligned to the Mathematics and English Language Arts (Reading and Writing) Pennsylvania Core Standards in kindergarten through grade 2, the K–2 Science Assessment Anchors and Eligible Content, and the Mathematics, English Language Arts, and Science Assessment Anchors and Eligible Content. The additional items made for a more robust pool of items from which the Diagnostic Category assessments and the full CDT could draw.

An additional set of items were developed in 2018 and 2019 for science. These items were aligned to the Science Assessment Anchors and Eligible Content. All additional items were technology-enhanced items meant to increase the rigor of the science pool as well as provide alternative ways to assess various science concepts. The additional items made for a more robust pool of science items from which the Diagnostic Category assessments and the full CDT could draw.

An additional set of items in were developed in 2021 for an embedded field test in 2022 and 2023. The purpose of this development was to supplement the pool with additional items in mathematics, English language arts and science. These items were aligned to the Mathematics and English Language Arts (Reading and Writing) Pennsylvania Core Standards in kindergarten through grade 2, the K–2 Science Assessment Anchors and Eligible Content, and the Mathematics, English Language Arts, and Science Assessment Anchors and Eligible Content. The additional items made for a more robust pool of items from which the Diagnostic Category assessments and the full CDT could draw.

ITEM DEVELOPMENT CONSIDERATIONS

Alignment to the PSSA and Keystone Assessment Anchors and Eligible Content, grade- or course-level appropriateness (as specified by PDE), depth of knowledge (DOK), item/task level of complexity, estimated difficulty level, relevancy of context, rationale for distractors, style, accuracy, and correct terminology were major considerations in the item development process. The *Standards for Educational and Psychological Testing* (AERA, APA, NCME, 1999) and the *Principles of Universal Design* (Thompson, Johnstone, & Thurlow, 2002) guided the development process. In addition, DRC's *Bias, Fairness, and Sensitivity Guidelines* were used for developing items. All items were reviewed for fairness by bias and sensitivity committees and for content by Pennsylvania educators and field specialists.

BIAS, FAIRNESS, AND SENSITIVITY OVERVIEW

At every stage of the item and test development process, DRC employs procedures that are designed to ensure that items and tests meet Standard 7.4 of the Standards for Educational and Psychological Testing (AERA, APA, NCME, 1999).

> *Standard 7.4: Test developers should strive to identify and eliminate language, symbols, words, phrases, and content that are generally regarded as offensive by members of racial, ethnic, gender, or other groups, except when judged to be necessary for adequate representation of the domain.*

To meet Standard 7.4, DRC employs a series of internal quality steps. DRC provides specific training for test developers, item writers, and reviewers on how to write, review, revise, and edit items for issues of bias, fairness, and sensitivity (as well as for technical quality). Training also includes an awareness of and sensitivity to issues of cultural diversity. In addition to providing *internal* training in reviewing items in order to eliminate potential bias, DRC also provides *external* training to the review panels of minority experts, teachers, and other stakeholders.

DRC's guidelines for bias, fairness, and sensitivity includes instruction concerning how to eliminate language, symbols, words, phrases, and content that might be considered offensive by members of racial, ethnic, gender, or other groups. Areas of bias that are specifically targeted include, but are not limited to, stereotyping, gender, regional/geographic, ethnic/cultural, socioeconomic/class, religious, experiential, and biases against a particular age group (ageism) or persons with disabilities. DRC catalogues topics that should be avoided and maintains balance in gender and ethnic emphasis within the pool of available items and passages.

UNIVERSAL DESIGN OVERVIEW

The Principles of Universal Design were incorporated throughout the item development process to allow participation of the widest possible range of students in the Classroom Diagnostic Tools. The following checklist was used as a guideline:

- Items measure what they are intended to measure.
- Items respect the diversity of the assessment population.
- Items have a clear format for text.
- Stimuli and items have clear pictures and graphics.
- Items have concise and readable text.
- The arrangement of the items on the test has an overall appearance that is clean and well organized.

A more extensive description of the application of the Principles of Universal Design is found in Chapter Four.

DEPTH OF KNOWLEDGE (DOK) OVERVIEW

An important element in statewide assessments is the alignment between the overall assessment system and the state's standards. A methodology developed by Norman Webb (1999, 2006) offers a comprehensive model that can be applied to a wide variety of contexts. With regard to the alignment between standards statements and the assessment instruments, Webb's criteria include five categories, one of which deals with content. Within the content category is a useful set of levels for evaluating depth of knowledge (DOK). According to Webb (1999), "depth-of-knowledge consistency between standards and assessments indicates alignment if what is elicited from students on the assessment is as demanding cognitively as what students are expected to know and do as stated in the standards" (p. 7–8). The four levels of cognitive complexity (i.e., depths of knowledge) are as follows:

- Level 1: Recall
- Level 2: Application of Skill/Concept
- Level 3: Strategic Thinking
- Level 4: Extended Thinking

Depth-of-knowledge levels were incorporated in the item writing and review process, and items were coded with respect to the level each represented.

PASSAGE READABILITY OVERVIEW

Evaluating the readability of a passage is essentially a judgmental process by individuals familiar with the classroom context and what is linguistically appropriate. Although various readability indices were computed and reviewed, it is recognized that such methods measure different aspects of readability and are often fraught with particular interpretive liabilities. Thus, the commonly available readability formulas were not used in a rigid way, but more informally to provide for several snapshots of a passage that senior test development staff considered along with experience-based judgments in guiding the passage selection process. In addition, passages were reviewed by committees of Pennsylvania educators who evaluated each passage for readability and grade-level appropriateness.

TEST ITEM READABILITY OVERVIEW

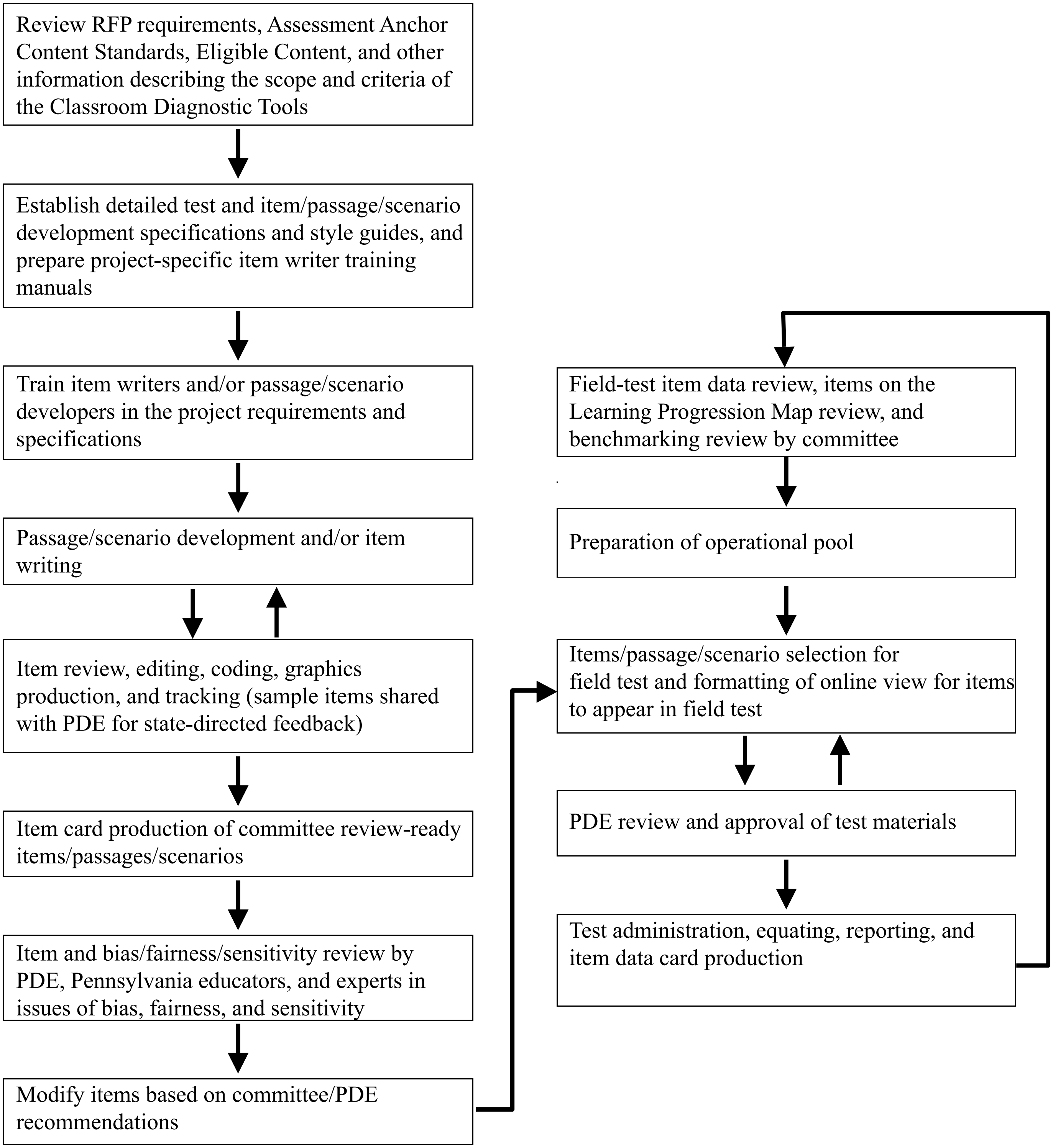
Careful attention was given to the readability of the items to make certain that the assessment focus of the item did not shift based on the difficulty of reading the item. Subject/course areas such as Mathematics, Algebra I, Science, or Biology contain many content-specific vocabulary terms. As a result, readability formulas were not used. However, wherever it was practicable and reasonable, every effort was made to keep the vocabulary at or one level below the grade or course level for non-Reading/Literature items. There was a conscious consideration made to ensure that each question was evaluating a student's ability to build toward mastery of the course standards versus the student's reading ability. Resources used to verify the vocabulary level were the *EDL Core Vocabularies* and the *Children's Writer's Word Book.*

In addition, every test question is brought before committees comprised of Pennsylvania educators who are course-level/grade-level experts in the content field in question. They review each question from the perspective of the students they teach, and they determine the validity of the vocabulary used and work to minimize the level of reading required.

ITEM AND TEST DEVELOPMENT CYCLE

The item development process for items followed a logical cycle and timeline, which is outlined in the figure on the following page. On the front end of the schedule, tasks were generally completed with the goal of presenting field test candidate items to committees of Pennsylvania educators. On the back end of the schedule, all tasks lead to the field test data review and operational test construction. This presentation represents a typical life cycle for a field test event.

DRC Item and Test Development Primary Cycle



GENERAL ITEM AND TEST DEVELOPMENT PROCESS

The following describes the processes which lead up to an operational assessment. These processes were used to develop the entire pool of items that appeared within the field test administrations for potential inclusion in the operational item pool.

ITEM DEVELOPMENT PLANNING MEETING

Prior to the start of any item development work, DRC's test development staff meets with PDE's assessment office to discuss the test development plans, including the test blueprint, the field test plan (including development counts), procedures, timelines, etc.

ITEM WRITER TRAINING

Item writers were selected and trained for the subject areas of Mathematics, Algebra I, Algebra II, Geometry, Science, Biology, Chemistry, Reading, Literature, Writing, and English Composition. Qualified writers were college graduates with teaching experience and a demonstrated base of knowledge in the content area. Many of these writers were content assessment specialists and curriculum specialists. The writers were trained individually and had previous experience in writing multiple-choice items. Prior to developing items for the Classroom Diagnostic Tools, the cadre of item writers was trained with regard to the following:

- PSSA and Keystone Assessment Anchors and Eligible Content
- Webb's Levels of Cognitive Complexity, Depth of Knowledge
- Bias, Fairness, and Sensitivity Guidelines
- Principles of Universal Design
- Item Quality Technical Style Guidelines
- Reference Information
- Sample Items

LITERATURE PASSAGE DEVELOPMENT

The task of developing passages was conducted by DRC professionals with classroom experience in reading/English language arts. These professionals also underwent specialized training (provided by DRC) in the characteristics of acceptable passages. Guidelines for passage development included appropriate length, text structure, density, and vocabulary. A judgment was also made about whether the reading level required by a particular passage was at the independent level—that is, where the average student should be able to read 90 percent of words in the text independently. Passage writers were given the task of writing a specified number of passages for each genre. Passages were commissioned by experienced authors.

Passages underwent an internal review by several test development content editors to judge their merit with regard to the following criteria:

- Passages have interest value for students.
- Passages are appropriate in terms of vocabulary and language characteristics.
- Passages are free of bias, fairness, and sensitivity issues.
- Passages represent different cultures.
- Passages are able to stand the test of time.
- Passages are sufficiently rich to generate a variety of multiple-choice items.
- Passages avoid dated subject matter unless a relevant historical context is provided.
- Passages should not require students to have extensive background knowledge in a certain discipline or area to understand a text.

Once through the internal review process, those passages deemed potentially acceptable were reviewed by the Reading Content Committee and Bias, Fairness, and Sensitivity Committee for final approval.

ITEM AUTHORING AND TRACKING

Initially, items are generated with software-prepared Classroom Diagnostic Tools Item Cards, which allows for preliminary sorting and reviewing. A column against the right margin includes codes to identify the subject area, grade, content categories, passage information (in the case of reading), item type, depth of knowledge (cognitive complexity), estimated difficulty, answer key, and calculator use (for mathematics items).

All items undergoing field testing were entered into the DRC Item Development and Educational Assessment System (IDEAS), which is a comprehensive, secure, online item banking system. It accommodates item writing, item viewing and reviewing, and item tracking and versioning. IDEAS manages the transition of an item from its developmental stage to its approval for use within a test form. The system supports item history records that include item usage within a form, item-level notes, content categories and subcategories, item statistics from both classical and Rasch item analyses, and classifications derived from analyses of differential item functioning (DIF).

INTERNAL REVIEWS

To ensure that the items produced were sufficient in number and adequately distributed across subcategories and levels of difficulty, item writers were informed of the required quantities of items. As items were written, an item authoring card was completed. It contained information about the item, such as subject, content category, and subcategories. Based on the item writer's classroom teaching experience, knowledge of the content area curriculum, and cognitive demands required by the item, estimates were recorded for level of cognitive complexity and difficulty level. Items were written to provide for a range of difficulties and cognitive complexities.

As part of the item construction process, each item was reviewed by content specialists and editors at DRC. Content specialists and editors evaluated each item to make sure that it measured the intended Eligible Content and Assessment Anchor. They also assessed each item to make certain that it was appropriate for the intended grade and that it provided only one correct answer. In addition, the difficulty level, depth of knowledge, graphics, language demand, and distractors were also evaluated. Other elements considered in this process include, but are not limited to, Universal Design, bias, source of challenge, grammar/punctuation, and Pennsylvania style. Following these reviews, the items were prepared for the content review meetings conducted with Pennsylvania educators.

ITEM CONTENT REVIEWS

Prior to the 2010, 2011, 2013, 2015, 2018, 2019 and 2022 field testing, all newly developed test items were submitted to content committees for review. The content committees consisted of Pennsylvania educators from school districts throughout the Commonwealth of Pennsylvania, some with postsecondary university affiliations. The primary responsibility of the content committee was to evaluate items for quality and content classification, including grade-level or course appropriateness, estimated difficulty, depth of knowledge, and source of challenge. With source of challenge, items are identified where the cognitive demand is focused on an unintended content, concept, or skill (Webb, 2002). In addition, source of challenge may be attributed if the reason that an answer could be given results from a cultural bias, an inappropriate reading level, or a flawed graphic in an item, or if an item requires specialized, non-content-related knowledge to answer. Source of challenge could result in a student who has mastered the intended content or skill answering the item incorrectly or a student who has not mastered the intended content or skill answering the item correctly. Committee members were asked to note any items with a source of challenge and to suggest revisions to remove the source of challenge. They also suggested revisions and made recommendations for reclassification of items. The committee members also reviewed the items for adherence to the Principles of Universal Design, including language demand and issues of bias, fairness, and sensitivity.

The content review meetings were held in January 2010 for Mathematics, Algebra I, Algebra II, and Geometry, in May/June 2010 for Reading/Literature, Science, Biology, and Chemistry, and in January 2011 for Writing/English Composition. Additional content review meetings were held in November 2012 (for the additional items aligned to the Pennsylvania Core Standards) and in July 2013 (for the items to allow students in grades 3 through 5 to participate in the CDT). Content review meetings were again held in May of 2015 for Writing items and June of 2015 for Science, Reading, and Math (for additional items aligned to the Pennsylvania Core Standards and the Assessment Anchors and Eligible Content to supplement the pool). Another set of content review meetings took place in January of 2018 to supplement the item pool. Another set of content review meetings took place in January of 2019 for Science technology enhanced items. The most recent content review meetings were held in the spring of 2022. Committee members were approved by PDE, and PDE-approved invitations were sent to them by DRC. PDE also selected internal staff members for attendance. The meeting commenced with a welcome by PDE and DRC. This was followed by an overview of the test development process by DRC. PDE, along with DRC, also provided training on the procedures and forms to be used for item content review.

DRC content assessment specialists facilitated the reviews and were assisted by representatives of PDE. Committee members, grouped by content area, received training by working through and reviewing a group of items for quality and content, as well as for the following categories:

- Assessment Anchor Alignment
- Content Limits
- Grade-Level (Course-Level) Appropriateness
- Difficulty Level
- Depth of Knowledge
- Appropriate Source of Challenge
- Correct Answer
- Quality of Distractors
- Graphics in Regards to Appropriateness
- Appropriate Language Demand
- Freedom from Bias

The members then received a binder containing items to independently review and provided their recommendation for the status of each item: Approved, Accepted with Revision, or Rejected. All comments were reviewed and addressed by DRC content staff, and, when necessary, PDE staff were consulted.

Security was addressed by adhering to a strict set of procedures. All attendees, with the exception of PDE staff, were required to sign a confidentiality agreement. All materials not in use at any time were stored in a locked room. Secure materials that did not need to be retained after the meetings were deposited in secure barrels, the contents of which were shredded.

BIAS, FAIRNESS, AND SENSITIVITY REVIEWS

Prior to the 2010, 2011, 2013, 2015, 2018, 2019 and 2022 field testing, all newly developed test items were also submitted to a Bias, Fairness, and Sensitivity Committee for review. These reviews took place prior to the Item Content Review for each content area. The committee's primary responsibility was to evaluate items with regard to bias, fairness, and sensitivity issues. They also made recommendations for changes or deletion of items in order to remove the potential for issues of bias, fairness, and/or sensitivity. Included in the review were proposed reading passages. An expert, multi-ethnic committee composed of men and women was trained by a DRC test development lead to review items for bias, fairness, and sensitivity issues. Training materials included a manual developed by DRC (DRC, 2003–2013). Members of the committee also had expertise with special-needs students and English Language Learners. All items were read by a cross-section of committee members. Each member noted bias, fairness, and/or sensitivity comments on tracking sheets and on the item, if needed, for clarification. Committee members individually categorized any concerns as related to ageism, disability, ethnicity/culture, gender, region, religion, socioeconomics, or stereotypes. These categories were the framework through which recommendations for modification or rejection of items occurred during the subsequent committee consensus process. The committee discussed each of the issues as a group and came to a consensus as to which issues should represent the view of the committee. All consensus comments were then compiled, and the suggested actions on these items were recorded and submitted to DRC content staff. This review followed the same security procedures as outlined above.

ITEMS ALIGNED TO LEARNING PROGRESSION MAPS

Following the initial field test of items, all items were brought before a committee of Pennsylvania educators for review of each item's alignment to the Learning Progression Map. DRC and PDE provided a general overview of the item and test development process for the Classroom Diagnostic Tools and provided information about the Learning Progression Maps and the purpose of the Classroom Diagnostic Tools. Then the committee reviewed the Learning Progression Map, which shows the vertical articulation of the Assessment Anchors and Eligible Content across grades within a given subject area. Once it was determined that the Learning Progression Map containing the Assessment Anchors and Eligible Content was an accurate representation of how the content progressed across grades, teachers worked in grade-span committees to review items for their alignment with the Assessment Anchor and Eligible Content. When reviewing the alignment to the Assessment Anchor and Eligible Content, educators considered whether the test item measured the content that it purported to measure, as well as the appropriateness of the difficulty and cognitive complexity of the item in relation to the Assessment Anchor and Eligible Content to which the item was aligned. Committees came to a consensus regarding the status of each item: Accepted, Accepted with Revised Alignment, or Rejected.

Security was addressed by adhering to a strict set of procedures. All attendees, with the exception of PDE staff, were required to sign a confidentiality agreement. All materials not in use at any time were stored in a locked room. Secure materials that did not need to be retained after the meetings were deposited in secure barrels, the contents of which were shredded.

CHAPTER FOUR: UNIVERSAL DESIGN PROCEDURES APPLIED TO THE CLASSROOM DIAGNOSTIC TOOLS TEST DEVELOPMENT PROCESS

UNIVERSAL DESIGN

Universally designed assessments allow participation of the widest possible range of students and contribute to valid inferences about participating students. Principles of Universal Design are based on the premise that each child in school is a part of the population to be tested and that testing results should not be affected by disability, gender, race, or English language ability (Thompson, Johnstone, & Thurlow, 2002). At every stage of the item and test development process, procedures were employed to ensure that items and subsequent tests were designed and developed using the elements of universally designed assessments developed by the National Center for Educational Outcomes (NCEO).

Federal legislation addresses the need for universally designed assessments. The No Child Left Behind Act (Elementary and Secondary Education Act) requires that each state must "provide for the participation in [statewide] assessments of all students" [Section 1111(b)(3)(C)(ix)(I)]. Both Title I and IDEA regulations call for universally designed assessments that are accessible and valid for all students, including students with disabilities and English Language Learners. The benefits of universally designed assessments not only apply to these groups of students, but to all individuals with wide-ranging characteristics. Therefore, it is important that the development of all assessments, including voluntary assessments such as the Classroom Diagnostic Tools, be guided by the Principles of Universal Design.

DRC's test development team was trained in the elements of Universal Design as it relates to developing large-scale statewide assessments. Team leaders were trained directly by NCEO, and other team members were subsequently trained by team leaders. Committees involved in content review included some members who were familiar with the unique needs of students with disabilities and English Language Learners. Likewise some members of the Bias, Fairness, and Sensitivity Committee were conversant with these issues. What follows are the Universal Design guidelines followed during all stages of the item development process for the Classroom Diagnostic Tools.

ELEMENTS OF UNIVERSALLY DESIGNED ASSESSMENTS

After a review of research relevant to the assessment development process and the Principles of Universal Design (Center for Universal Design, 1997), NCEO has produced seven elements of Universal Design as they apply to assessments (Thompson, Johnstone & Thurlow, 2002). These elements served to guide item development for the Classroom Diagnostic Tools.

- **Inclusive Assessment Population**

  The target population includes students attending Commonwealth schools in grades 3 through 12 who will be participating in either the Pennsylvania System of School Assessment or the Keystone Exams.

- **Precisely Defined Constructs**

  An important function of well-designed assessments is that they actually measure what they are intended to measure. The Assessment Anchor Content Standards and Eligible Content for both PSSA and the Keystone Exams, as well as the Pennsylvania Academic Standards for Writing, provided clear descriptions of the constructs to be measured by the Classroom Diagnostic Tools assessments. Universally designed assessments must remove all non-construct-oriented cognitive, sensory, emotional, and physical barriers.

- **Accessible, Non-biased Items**

  DRC conducted both internal and external reviews of items and test specifications to ensure that they did not create barriers because of lack of sensitivity to disability, culture, or other subgroups. Items and test specifications were developed by a team of individuals who understand the varied characteristics of items that might create difficulties for any group of students. Accessibility is incorporated as a primary dimension of test specifications, so accessibility was woven into the fabric of the test rather than being added after the fact.

- **Amenable to Accommodations**

  Even though items on universally designed assessments are accessible for most students, there are some students who continue to need accommodations. This essential element of a universally designed assessment requires that the exam is compatible with accommodations and a variety of widely used adaptive equipment and assistive technology.

- **Simple, Clear, and Intuitive Instructions and Procedures**

  Assessment instructions should be easy to understand, regardless of a student's experience, knowledge, language skills, or current concentration level. Questions that are posed using complex language can invalidate the test if students cannot understand how they are expected to respond to a question. To meet this guideline, directions and questions were prepared in simple, clear, and understandable language that underwent multiple reviews.

- **Maximum Readability and Comprehensibility**

  A variety of guidelines exist to ensure the maximum readability and comprehensibility of a test. These features go beyond what is measured by readability formulas. Readability and comprehensibility are affected by many factors, including student background, sentence difficulty, text organization, and others. All of these features were considered as item text was developed.

  Plain language is a concept now being highlighted in research on assessments. Plain language has been defined as language that is straightforward and concise. The following strategies for editing text to produce plain language were used during the editing process of the Classroom Diagnostic Tools items:

  - Reduction of excessive length
  - Use of common words
  - Avoidance of ambiguous words
  - Avoidance of irregularly spelled words
  - Avoidance of proper names
  - Avoidance of inconsistent naming and graphic conventions
  - Avoidance of unclear signals about how to direct attention

- **Maximum Legibility**

  Legibility is the physical appearance of text, the way that the shapes of letters and numbers enable people to read text easily. Bias can result when tests contain physical features that interfere with a student's focus on or understanding of the constructs that test items are intended to assess. A style guide was developed and was utilized which included dimensions of style consistent with Universal Design.

GUIDELINES FOR UNIVERSALLY DESIGNED ITEMS

All test items written and reviewed adhered closely to the following guidelines for Universal Design. Item writers and reviewers used a checklist during the item development process to ensure that each aspect was attended to.

1. **Items measure what they are intended to measure.** Item writing training included ensuring that writers and reviewers had a clear understanding of Pennsylvania's Core Standards, Pennsylvania's Academic Standards, and the PSSA and Keystone Assessment Anchors and Eligible Content. During all phases of test development, items were presented with content-standard information to ensure that each item reflected the intended Academic Standard (Mathematics, Reading, and Writing items aligned to Kindergarten, grade 1, or grade 2) or Eligible Content (all other grades and content areas). Careful consideration of the content standards was important in determining which skills involved in responding to an item were extraneous and which were relevant to what was being tested. In certain types of items an additional skill is necessary, such as the Algebra I test, which requires the student to read.

2. **Items respect the diversity of the assessment population.** To develop items that avoid content that might unfairly advantage or disadvantage any student subgroup, item writers, test developers, and reviewers were trained to write and review items to avoid issues of bias, fairness, and sensitivity. Training also included an awareness of, and sensitivity to, issues of cultural and regional diversity.

3. **Items have a clear format for text.** Decisions about how items are presented to students must allow for maximum readability for all students. Appropriate fonts and point sizes were employed with minimal use of italics, which is far less legible and is read considerably more slowly than standard typeface. Captions, keys, and legends were at least a 12-point size, while footnotes and sentence numbers use a 10-point font.[1] Legibility was enhanced by sufficient spacing between letters, words, and lines. Blank space around paragraphs and between columns and staggered right margins were used.

4. **Stimuli and items have clear pictures and graphics.** When pictures and graphics were used, they were designed to provide essential information in a clear and uncluttered manner. Illustrations were placed directly next to the information to which they referred, and labels were used where possible. Sufficient contrast between background and text, with minimal use of shading, increased readability for students with visual impairments. Color was not used to convey important information.

5. **Items have concise and readable text.** Linguistic demands of stimuli and items can interfere with a student's ability to demonstrate knowledge of the construct being assessed. During item writing and review, the following guidelines were used.

   - Simple, clear, commonly used words were used whenever possible.
   - Extraneous text was omitted.
   - Vocabulary and sentence complexity were appropriate for the grade level being assessed.
   - Technical terms and abbreviations were used only if they were related to the content being measured.
   - Definitions and examples were clear and understandable.
   - Idioms were avoided unless idiomatic speech was being assessed.
   - The questions to be answered were clearly identifiable.

6. **Items allow changes to format without changing meaning or difficulty.** An audio accommodation is available in Mathematics Lower Grades, Mathematics, Algebra I, Geometry, Algebra II, Science Lower Grades, Science, Biology, and Chemistry for any student with Individualized Education Program (IEP) requirements related to receiving audio assistance during testing. Additionally, a Magnifier tool that can be used to enlarge an area of the screen is available to all students. This tool can be used at the same time as other tools, such as the Highlighter or Line Guide.

7. **The test has an overall appearance that is clean and organized.** Images, pictures, and text that may not be necessary (e.g., sidebars, overlays, callout boxes, shading, visual crowding caused by excess information) and that could be potentially distracting to students were avoided. Also avoided were purely decorative features that did not serve a purpose. Information was organized in a left-right, top-bottom format.

ITEM DEVELOPMENT

DRC works closely with the Pennsylvania Department of Education to help ensure that the Classroom Diagnostic Tools comply with nationally recognized Principles of Universal Design. In addition to the Principles of Universal Design as described in the Classroom Diagnostic Tools Technical Report, DRC applies to each exam the standards for test accessibility as described in *Tests Access: Making Tests Accessible for Students with Visual Impairments—A Guide for Test Publishers, Test Developers, and State Assessment Personnel* (Allman, 2004).

To this end, DRC ensures that committee members at item and bias reviews are made aware of the Principles of Universal Design and of issues that may adversely affect students with disabilities with the goal of ensuring that Classroom Diagnostic Tools assessments are bias-free for all students.

[1] While font size follows specific requirements during online setup of an exam, the screen resolution used at the local level can impact the effective font size visible to the student.

ITEM FORMAT

For all Classroom Diagnostic Tools assessments, DRC formats the items to maximize accessibility for all students by using text that is in a size and font style that is easily readable. DRC limits shading, graphics, and charts. DRC ensures that graphics, pictures, diagrams, charts, and tables are positioned on the page with the associated test items. DRC uses high contrast for text and background where possible to convey pertinent information.

DRC ensures consistency across Classroom Diagnostic Tools assessments by following these Principles of Universal Design:

- High contrast and clarity is used to convey detailed information.
- Typically, shading is avoided; when necessary for content purposes, 10-percent screens are used as the standard.
- Overlaid print on diagrams, charts, and graphs is avoided.
- Charts, graphs, diagrams, and tables are clearly labeled with titles and with short descriptions where applicable.
- Only relevant information is included in diagrams, pictures, and graphics.
- Symbols used in keys and legends are meaningful and provide reasonable representations of the topics they depict.

ASSESSMENT ACCOMMODATIONS

While universally designed assessments provide for participation of the widest range of students, many students require accommodations in order to participate in the regular assessment. Clearly, the intent of providing accommodations for students is to ensure that students are not unfairly disadvantaged during testing and that the accommodations used during instruction, if appropriate, are made available as students take the test. The literature related to assessment accommodations is still evolving and often focuses on state policies regulating accommodations rather than on providing empirical data that supports the reliability and validity of the use of accommodations. On a yearly basis, the Pennsylvania Department of Education examines accommodations policies and current research to ensure that valid, acceptable accommodations are available for students. At this time, an audio accommodation is available in Mathematics Lower Grades, Mathematics, Algebra I, Geometry, Algebra II, Science Lower Grades, Science, Biology, and Chemistry for any student with Individualized Education Program (IEP) requirements related to receiving audio assistance during testing. A separate audio accommodation is available for all CDT assessments for students with visual impairments. Additionally, a color choices accommodation allows students who would benefit from a background other than white to select a background color from five available choices (in addition to the white background). A contrasting color allows students who would benefit from different text and background color combinations to select from seven options (in addition to black text on a white background).

CHAPTER FIVE: TEST ADMINISTRATION PROCEDURES

TEST SETUP

The process to set up students to take the Classroom Diagnostic Tools (CDT) is accomplished through an online interface located on the DRC INSIGHT Portal (https://www.drcedirect.com/all/eca-portal-ui/welcome/PA). The DRC INSIGHT Portal is a permission-based site that enables districts to assign users different roles and permissions depending on their role in the setup process. Each district can set up users with as much or as little permission as deemed necessary. A user's role and permission may be modified at any time.

The student and teacher information can be imported into the Portal at any time. Once the data is imported, users organize students into student groups and test sessions. Student groups and test sessions can be created by class, grade, school, or any other variation.

Each student group is assigned to a specific teacher. Students may belong to multiple student groups and multiple teachers can be assigned to the same student group. This allows districts/schools the ability to allow multiple users to view the data by class, grade, or even school. Student groups may be created and modified at any time during the administration window.

Test sessions are generated to create test tickets that are distributed to students prior to testing. A test ticket contains the student's full name, username, password, and the assessment he/she will be taking. The test session, like the student group, may also be created by class, grade, or school. Each time an assessment is administered, a new test session must be created. Test sessions can be copied to simplify administering the CDT to the same students multiple times each year.

SAMPLE TEST SESSION TICKET

CDT

ASHLEE ABBOTT

Reading/Literature

Username: 3924540101

Password: SWAM8481

The CDT is untimed. Each full CDT should take the typical student 50 to 90 minutes to complete and is between 48 and 60 items in length. Each Diagnostic Category (DC) CDT should take the typical student 20–30 minutes to complete. The writing, science and math Diagnostic Category CDTs are between 15–18 items. The reading Diagnostic Category CDTs are between 35–45 items. The CDT may be administered in one sitting, but it is possible to administer the CDT over multiple days and recommended for the Grades 3–5 assessments.

Teachers have flexibility in using the different full and diagnostic category tests within a school year. For instance, some elementary teachers may choose to use the full mathematics CDT at the beginning of the year to understand where their students are starting, and follow-up with DC tests as they go through different units. High school teachers may choose a DC test first, based on the course or unit of study. Regardless of how the CDT is used in the classroom, there should be enough time between CDT administrations to allow for instructional impact to be reflected in the student's results. Though there are no restrictions on the time between CDT administrations, there is a restriction in the Test Setup system that only allows a student to be associated with a single CDT/DC CDT a maximum of five (5) times within a given school year.

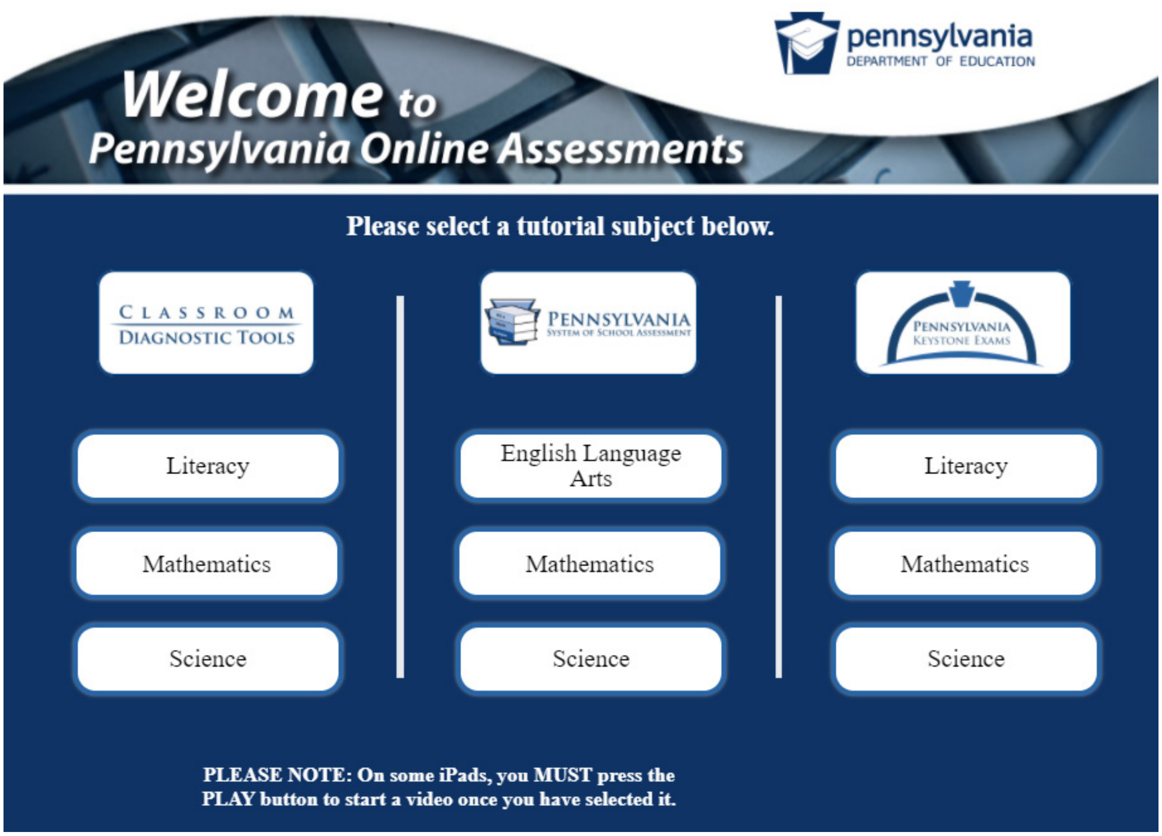
PA ONLINE ASSESSMENTS SOFTWARE

Prior to testing, each student computer needs to have the PA Online Assessments software installed. The testing software downloads are located on the DRC INSIGHT Portal. The installer is an MSI file that can be pushed out across a server to expedite the installation process. Once the software is installed, users also have access to the PA Assessment Online Student Tutorials and the PA Assessment Online Tools Training (OTT).

The PA Assessment Online Tools Training (OTT) is designed to provide an introductory experience using the online assessment software in preparation for taking the CDT. The purpose of the OTT is for students to observe and experiment with the features of the online assessment software prior to the actual assessment. The OTT is NOT designed to demonstrate complete coverage of the tested content, and it is NOT scored. Rather, sample items have been chosen to demonstrate online assessment features and uses.

Technology coordinators are encouraged to run the Online Tools Training prior to testing because it interacts with DRC servers exactly like an actual CDT assessment. Completion of the OTT will provide a good indication that the software installed correctly, and everything is configured properly on the network.

The web-based PA Online Assessment Student Tutorials are available for each operational assessment and are designed to be used by students at all grade levels. They use pictures, motion, and sound to present visual and verbal descriptions of the features and functionality of the PA Online Assessment system. It is recommended to allow a minimum of 20 minutes to view the tutorials. Tutorials may be reviewed as often as needed.



TRAINING AND CUSTOMER SERVICE SUPPORT

Prior to testing, training was provided to District Technology Coordinators and District Assessment Coordinators. All training was administered via web conference and lasted approximately 1½ hours. Test Coordinator Training goes over tasks that need to be completed prior to testing. A large portion of the training is dedicated to the setup of users and the creation of student groups and test sessions.

Technology Coordinator Training focuses on all technical aspects required for the setup of the CDT. Detailed installation instructions for the PA Online Assessments Software and Central Office Services – Service Device (COS-SD) are provided. The COS-SD runs on a server within the local network and helps mitigate internet traffic by allowing student machines to retrieve items from the COS-SD rather than from DRC servers. The CDT requires an internet connection at all times.

Users are encouraged to call or email DRC with any questions or error messages that cannot be resolved. If the problem cannot be resolved via a customer service representative, the issue is escalated to DRC developers. Ninety percent of the time, a solution is provided within twenty-four hours. If the issue requires more research, DRC will contact the caller daily to provide an update.

CHAPTER SIX: FIELD TEST

FIELD TEST OVERVIEW

All items appearing in the 2021–2022 Classroom Diagnostic Tools (CDT) operational item pools were field tested prior to their use on the operational CDT. The purpose of administering field-test items is to obtain statistics for them so they can be reviewed and approved before becoming operational. Based on this statistical review, many of the field-test items were selected for use in the 2021–2022 CDT operational item pools.

There were nine separate CDT field-test events that contributed items to the 2021–2022 operational item pools—four stand-alone field-test events and five embedded field-test events. Separate field-test events were needed because the operational CDT was rolled out in phases by content area and available grades.

There were three stand-alone field-test events to build the item pools for students in grade 6 and above. Items in mathematics were field tested in spring 2010. Items in reading and science were field tested in fall 2010. Items in writing were field tested in spring 2011. During these three field-test events, CDT items were field tested on stand-alone fixed forms. The forms were administered in computer-based format only. No paper/pencil versions were available. Field test administration mode was limited to computer-based to mirror the operational CDT, which is an adaptive test requiring computer administration. CDT stand-alone field tests were designed to build vertical scales across all grades and courses within a content area. In order to accomplish this, some field-test forms had items from one grade above or below in addition to on-grade level items. For example, some grade 7 mathematics forms contained items from grade 6 in addition to items from grade 7. Other grade 7 mathematics forms contained items from both grade 7 and grade 8. See Chapter Nine for more details.

There was one stand-alone field-test event to build the item pools for students in grades 3 through 5. Items in mathematics, reading, science, and writing were field tested in fall 2013. Again, CDT items were field tested on stand-alone fixed forms. The forms were administered in computer-based format only. No paper/pencil versions were available. In order to link to the existing operational scales, some operational grade-level items were included in the field-test forms. See Chapter Twelve for more details.

In addition to the four stand-alone field-test events that contributed items to the 2021–2022 operational item pools, there were five field-test events in which a small number of field-test items were included (embedded) within the operational CDT. In spring 2013, field-test items were included in mathematics and reading. The purpose of this embedded field test was to add items to the operational item pools that align to the Pennsylvania Core Standards. In fall 2013, field-test items were included in mathematics, reading, science, and writing. The purpose of this embedded field test was to field test additional items in grade 5 that could be used in the item pools for students in grades 3 through 5. In 2015–2016, seven of the thirteen CDTs included a small number of embedded field-test items. The purpose of this embedded field test was to supplement the existing item pools and to introduce the evidence-based selected-response (EBSR) item type in the reading content area. In 2018–2019, all CDTs included a small number of embedded field-test items. The purpose of this embedded field test was to supplement the existing item pools in all content areas and grades/courses. In 2019–2020, all CDTs in the science content area except Chemistry included a small number of embedded field-test items in addition to the operational items used to generate a student's score. The purpose of the embedded field test was to supplement the existing item pools and to introduce the technology-enhanced (TE) item type.

In the case of all five embedded field-test events, field-test items were included within the operational administration and students did not know which items were field-test items (items that do not count toward a student's score). Therefore, the embedded field-test items can be linked to the existing operational scales. See Chapter Twelve for details.

CDT STAND-ALONE FIELD TESTS

SPRING 2010—MATHEMATICS

The stand-alone field test administered in spring 2010 was designed to yield enough items to populate the item pool for CDT Mathematics. Items covering the Eligible Content in grades 3 through 8 and courses Algebra I, Geometry, and Algebra II were field tested. Items covering grade 11 Eligible Content that were NOT covered in Algebra I, Geometry, or Algebra II were also field tested.

Participation in the field test was voluntary. All schools that wanted to participate were allowed to field test. All students in volunteer schools were encouraged, but not required, to participate.

In order to encourage participation, field-test forms were limited in length. Forms for grades 3, 4, and 5 had 25 items. Forms for grades 6, 7, and 8 and Algebra I, Geometry, and Algebra II courses had 35 items. There were not separate grade 11 forms. Instead, grade 11 items were included on grade 8, Algebra I, Geometry, and Algebra II forms.

Since testing occurred in spring, students had nearly a full year of instruction. Therefore, grade-level forms were assigned to students in the corresponding grade (e.g., students in grade 7 took grade 7 forms). Course-level forms were assigned to students currently taking the course (e.g., students in a Geometry course took Geometry forms).

Each student was randomly assigned one of the appropriate grade- or course-level forms at the time of testing.

Table 6–1. Spring 2010 Mathematics Field-Test Form Details

Grade/Course	Number of Items	Number of Forms	Number of Vertical Linking Forms
Grade 3	86	8	4
Grade 4	86	10	8
Grade 5	85	10	8
Grade 6	259	16	8
Grade 7	258	16	8
Grade 8	257	18	12
Grade 11*	149	0	0
Algebra I	256	18	8
Geometry	257	16	4
Algebra II	256	16	4

* Grade 11 items were tested on grade 8, Algebra I, Geometry, and Algebra II forms.

FALL 2010—READING AND SCIENCE

The stand-alone field tests administered in fall 2010 were designed to yield enough items to populate the item pools for CDT Reading/Literature and CDT Science. Reading items covering the Eligible Content in grades 3 through 8 and Literature were field tested. Science items covering the Eligible Content in grades 3 through 8 and Biology and Chemistry courses were field tested. Items covering grade 11 science Eligible Content that were NOT covered in Biology or Chemistry were also field tested.

Participation in the field test was voluntary. All schools that wanted to participate were allowed to field test. All students in volunteer schools were encouraged, but not required, to participate. Schools were allowed to field test in both content areas.

In order to encourage participation, field-test forms were limited in length. Forms for grades 3, 4, and 5 had 25 items. Forms for grades 6, 7, and 8 and Literature, Biology, and Chemistry courses had 35 items. There were not separate grade 11 science forms. Instead, grade 11 science items were included on grade 8 science forms.

Since testing occurred in fall, students did NOT have a full year of instruction at their current grade level. Grade-level forms were therefore assigned one grade lower (e.g., students in grade 7 took grade 6 forms). Course-level forms were assigned to students who had completed the course during the prior school year.

Each student was randomly assigned one of the appropriate grade- or course-level forms at the time of testing.

Table 6–2. Fall 2010 Reading/Literature Field-Test Form Details

Grade/Course	Number of Items	Number of Forms	Number of Vertical Linking Forms
Grade 3	86	7	2
Grade 4	87	8	4
Grade 5	86	8	4
Grade 6	210	10	4
Grade 7	192	9	4
Grade 8	192	9	4
Literature	348	15	2

Table 6–3. Fall 2010 Science Field-Test Form Details

Grade/Course	Number of Items	Number of Forms	Number of Vertical Linking Forms
Grade 3	91	7	2
Grade 4	123	11	4
Grade 5	102	9	4
Grade 6	178	9	4
Grade 7	327	15	4
Grade 8	377	22	6
Grade 11*	115	0	0
Biology	390	16	2
Chemistry	335	14	2

* Grade 11 items were tested on grade 8 forms.

SPRING 2011—WRITING

The stand-alone field test administered in spring 2011 was designed to yield enough items to populate the item pool for CDT Writing/English Composition. Items covering the Pennsylvania Academic Standards for Writing in grades 3 through 8 and the Eligible Content for English Composition were field tested.

Participation in the field test was voluntary. All schools that wanted to participate were allowed to field test. All students in volunteer schools were encouraged, but not required, to participate.

In order to encourage participation, field-test forms were limited in length. Forms for grades 3, 4, and 5 had 25 items. Forms for grades 6, 7, and 8 and English Composition had 35 items.

Since testing occurred in spring, students had nearly a full year of instruction. Therefore, grade-level forms were assigned to students in the corresponding grade (e.g., students in grade 7 took grade 7 forms).

Each student was randomly assigned one of the appropriate grade- or course-level forms at the time of testing.

Table 6–4. Spring 2011 Writing/English Composition Field-Test Form Details

Grade/Course	Number of Items	Number of Forms	Number of Vertical Linking Forms
Grade 3	140	10	2
Grade 4	149	12	4
Grade 5	165	13	4
Grade 6	193	9	4
Grade 7	176	9	4
Grade 8	195	9	4
English Composition	365	15	2

FALL 2013—MATHEMATICS, READING, SCIENCE, AND WRITING

The stand-alone field tests administered in fall 2013 were designed to yield enough items to populate the item pools for each CDT for students in grades 3 through 5 in mathematics, reading, science, and writing. Items covering the Eligible Content in kindergarten through grade 4 were field tested[1]. In order to link to the existing operational scales, some operational grade-level items were included in the field-test forms.

Participation in the field test was voluntary. All schools that wanted to participate were allowed to field test. All students in volunteer schools were encouraged, but not required, to participate. Schools were allowed to field test in all content areas. In order to encourage participation, field-test forms were limited in length. All field-test forms had 25 items.

Since testing occurred in fall, students did NOT have a full year of instruction at their current grade level. Grade-level forms were therefore assigned one grade lower (e.g., students in grade 4 took forms containing grade 3 items). Each student was randomly assigned one of the appropriate grade-level forms at the time of testing.

[1] Items in grade 5 were part of the fall 2013 embedded field test.

Table 6–5. Fall 2013 Mathematics Field-Test Form Details

Student Grade	Item Grade(s)	Item Type	Number of Items	Number of Forms
Grade 3	K, 1, 2	Field Test	60, 90, 130	14
Grade 3	3	Link to Op Scale	15	14
Grade 4	3	Field Test	235	12
Grade 4	3	Link to Op Scale	15	12
Grade 5	4	Field Test	248	13
Grade 5	4	Link to Op Scale	15	13

Table 6–6. Fall 2013 Reading Field-Test Form Details

Student Grade	Item Grade(s)	Item Type	Number of Items	Number of Forms
Grade 3	K, 1, 2	Field Test	84, 98, 98	14
Grade 3	3	Link to Op Scale	15	14
Grade 4	3	Field Test	178	9
Grade 4	3	Link to Op Scale	15	9
Grade 5	4	Field Test	189	10
Grade 5	4	Link to Op Scale	15	10

Table 6–7. Fall 2013 Science Field-Test Form Details

Student Grade	Item Grade(s)	Item Type	Number of Items	Number of Forms
Grade 3	K–2 grade span	Field Test	280	14
Grade 3	3	Link to Op Scale	15	14
Grade 4	3	Field Test	155	8
Grade 4	3	Link to Op Scale	15	8
Grade 5	4	Field Test	213	11
Grade 5	4	Link to Op Scale	15	11

Table 6–8. Fall 2013 Writing Field-Test Form Details

Student Grade	Item Grade(s)	Item Type	Number of Items	Number of Forms
Grade 3	K, 1, 2	Field Test	44, 118, 117	14
Grade 3	3	Link to Op Scale	15	14
Grade 4	3	Field Test	60	3
Grade 4	3	Link to Op Scale	15	3
Grade 5	4	Field Test	60	3
Grade 5	4	Link to Op Scale	15	3

CDT EMBEDDED FIELD TESTS

SPRING 2013—MATHEMATICS AND READING

The embedded field test administered in spring 2013 was designed to augment the existing mathematics and reading/literature item pools. Items were aligned to the Pennsylvania Core Standards. Starting on February 14, 2013, all students testing CDT Mathematics took 5 field-test items. All students testing CDT Reading/Literature took 5–7 field-test items, depending on passage length. Students did not know which items were operational and which were field test. Field-test items did not count in calculation of total or diagnostic category scores. Since testing occurred in spring, students had received nearly a full year of instruction. Therefore, grade-level items were assigned to students in the corresponding grade wherever possible.

Table 6–9. Spring 2013 Embedded Field Test Details

Content Area	Grade/Course	Number of Items
Mathematics	Grade 3*	56
Mathematics	Grade 4*	67
Mathematics	Grade 5*	41
Mathematics	Grade 6	156
Mathematics	Grade 7	73
Mathematics	Grade 8	157
Reading	Grade 3*	58
Reading	Grade 4*	71
Reading	Grade 5*	60
Reading	Grade 6	56
Reading	Grade 7	58
Reading	Grade 8	57

*Items in grades 3 through 5 were initially field tested with students in grade 6 because CDT is available to students in grade 6 and above. However, this plan was revised after a few weeks of testing in favor of stand-alone field tests in fall 2013 with students in grades 3 through 5.

FALL 2013—MATHEMATICS, READING, SCIENCE, AND WRITING

The embedded field test administered in fall 2013 was designed to field test the grade 5 items needed to populate the item pools for each CDT for students in grades 3 through 5 in mathematics, reading, science, and writing. Starting on August 26, 2013, students in grade 6 testing CDT Mathematics, CDT Science, or CDT Writing/English Composition took 5 field-test items. Students in grade 6 testing CDT Reading/Literature took 5–7 field-test items, depending on passage length. Students did not know which items were operational and which were field test. Field-test items did not count in calculation of total or diagnostic category scores. Since testing occurred in fall, students had not received a full year of instruction. Therefore, grade 5 items were assigned to grade 6 students.

Table 6–10. Fall 2013 Embedded Field Test Details

CDT	Grade	Number of Items
Mathematics	Grade 5	221
Reading/Literature	Grade 5	134
Science	Grade 5	152
Writing/English Composition	Grade 5	71

FALL 2015—MATHEMATICS, READING, SCIENCE, AND WRITING

The embedded field test administered in fall 2015 was designed to field test new items to supplement the item pools in grades 6 and above in mathematics, reading, science, and writing as well as courses Algebra I and Biology. Additionally, the evidence-based selected-response item type was field tested in grades 3 through 8 reading.

Table 6–11. Fall 2015 Embedded Field Test Item Pools

Content Area	Item Grade/Course	Number of MC Items	Number of EBSR Items	Total Number of Items
Mathematics	6	122	0	122
Mathematics	7	177	0	177
Mathematics	8	151	0	151
Mathematics	Algebra I	150	0	150
Reading	3	0	22	22
Reading	4	0	22	22
Reading	5	0	22	22
Reading	6	105	21	126
Reading	7	105	21	126
Reading	8	105	21	126
Reading	Literature	126	0	126
Science	6	72	0	72
Science	7	159	0	159
Science	8	238	0	238
Science	Biology	136	0	136
Writing	6	93	0	93
Writing	7	93	0	93
Writing	8	110	0	110
Writing	English Composition	104	0	104

Starting on August 24, 2015, seven of the thirteen CDTs included embedded field-test items:

- Students using CDT Math Grades 6–HS, CDT Science Grades 6–HS, and CDT Writing/Eng Comp Grades 6–HS took 5 field-test items. Since testing occurred throughout the year, items were given to students whose grade matched the item's grade and to students one grade above the item's grade (e.g., grade 7 items were given to students in grades 7 and 8).
- Students using CDT Reading/Lit Grades 6–HS took one field-test passage and six associated items. Since testing occurred throughout the year, items were given to students whose grade matched the item's grade and to students one grade above the item's grade (e.g., grade 7 items were given to students in grades 7 and 8).
- Students using CDT Algebra I and CDT Biology took 5 field-test items from the relevant course.
- The only field-test items in grades 3 through 5 reading were EBSR items associated with existing operational passages. Students using CDT Reading Grades 3–5 were eligible to receive field-test EBSR items. However, operational passages that were not a good fit based on a student's performance were not administered just for the sake of field-test items. Instead, a field-test EBSR was administered only if the operational passage was selected for the student. The number of field-test EBSRs was limited to 3 per test.

In all cases, students did not know which items were operational and which were field test. Field test items did not count in the calculation of total or diagnostic category scores.

Table 6–12. Fall 2015 Embedded Field Test Design

Content Area	CDT	Item Grade/Course	Number of Items Embedded	Student Test Grade(s)
Mathematics	Math Grades 6–HS	6	5 MC	6,7
Mathematics	Math Grades 6–HS	7	5 MC	7, 8
Mathematics	Math Grades 6–HS	8	5 MC	8, 9+
Mathematics	Algebra I	Algebra I	5 MC	Algebra I
Reading	Reading Grades 3–5	3	0–3 EBSR	3,4,5
Reading	Reading Grades 3–5	4	0–3 EBSR	3,4,5
Reading	Reading Grades 3–5	5	0–3 EBSR	3,4,5
Reading	Reading/Lit Grades 6–HS	6	1 passage*	6,7
Reading	Reading/Lit Grades 6–HS	7	1 passage*	7, 8
Reading	Reading/Lit Grades 6–HS	8	1 passage*	8, 9+
Reading	Reading/Lit Grades 6–HS	Literature	1 passage*	9+
Science	Science Grades 6–HS	6	5 MC	6,7
Science	Science Grades 6–HS	7	5 MC	7, 8
Science	Science Grades 6–HS	8	5 MC	8, 9+
Science	Biology	Biology	5 MC	Biology
Writing	Writing/Eng Comp Gr 6–HS	6	5 MC	6,7
Writing	Writing/Eng Comp Gr 6–HS	7	5 MC	7, 8
Writing	Writing/Eng Comp Gr 6–HS	8	5 MC	8, 9+
Writing	Writing/Eng Comp Gr 6–HS	English Composition	5 MC	9+

* FT reading passages include six multiple-choice items OR five multiple-choice items and one evidence-based selected-response item.

FALL 2018—MATHEMATICS, READING, SCIENCE, AND WRITING

The embedded field test administered in fall 2018 was designed to field test new items to supplement the item pools in all content areas and grades/courses.

Table 6–13. Fall 2018 Embedded Field Test Item Pools

Content Area	Item Grade/Course	Number of MC Items	Number of EBSR Items	Total Number of Items
Mathematics	Kindergarten	20	0	20
Mathematics	1	20	0	20
Mathematics	2	20	0	20
Mathematics	3	178	0	178
Mathematics	4	179	0	179
Mathematics	5	180	0	180
Mathematics	6	96	0	96
Mathematics	7	103	0	103
Mathematics	8	99	0	99
Mathematics	Algebra I	299	0	299
Mathematics	Geometry	100	0	100
Mathematics	Algebra II	100	0	100
Reading	Kindergarten	32	0	32
Reading	1	20	0	20
Reading	2	32	0	32
Reading	3	135	27	162
Reading	4	135	27	162
Reading	5	135	27	162
Reading	6	102	21	123
Reading	7	102	21	123
Reading	8	99	21	120
Reading	Literature	249	0	249
Science	2	31	0	31
Science	3	89	0	89
Science	4	95	0	95
Science	5	90	0	90
Science	6	97	0	97
Science	7	99	0	99
Science	8	102	0	102
Science	Biology	290	0	290
Science	Chemistry	100	0	100

Table 6–13 (continued). Fall 2018 Embedded Field Test Item Pools

Content Area	Item Grade/Course	Number of MC Items	Number of EBSR Items	Total Number of Items
Writing	Kindergarten	10	0	10
Writing	1	10	0	10
Writing	2	12	0	12
Writing	3	99	0	99
Writing	4	90	0	90
Writing	5	90	0	90
Writing	6	93	0	93
Writing	7	111	0	111
Writing	8	93	0	93
Writing	English Composition	294	0	294

Starting on August 20, 2018, all CDTs included embedded field-test items:

- Students using grade level tests in content areas math, science, and writing took five field-test items. Since testing occurred throughout the year, items were given to students whose grade matched the item's grade and to students one grade above the item's grade (e.g., grade 7 items were given to students in grades 7 and 8).
- Students using CDTs in the reading content area took one field-test passage with four to six associated items. Since testing occurred throughout the year, items were given to students whose grade matched the item's grade and to students one grade above the item's grade (e.g., grade 7 items were given to students in grades 7 and 8).
- Students using CDT Algebra I, CDT Geometry, CDT Algebra II, CDT Biology, and CDT Chemistry took 5 field-test items from the relevant course.

In all cases, students did not know which items were operational and which were field test. Field test items did not count in calculation of total or diagnostic category scores.

Table 6–14. Fall 2018 Embedded Field Test Design

Content Area	CDT	Item Grade/Course	Number of Items Embedded	Student Test Grade(s)
Mathematics	Math Grades 3–5	Kindergarten	5 MC	3
Mathematics	Math Grades 3–5	1	5 MC	3
Mathematics	Math Grades 3–5	2	5 MC	3
Mathematics	Math Grades 3–5	3	5 MC	3,4
Mathematics	Math Grades 3–5	4	5 MC	4,5
Mathematics	Math Grades 3–5	5	5 MC	5,6
Mathematics	Math Grades 6–HS	6	5 MC	6,7
Mathematics	Math Grades 6–HS	7	5 MC	7, 8
Mathematics	Math Grades 6–HS	8	5 MC	8, 9+
Mathematics	Algebra I	Algebra I	5 MC	Algebra I
Mathematics	Geometry	Geometry	5 MC	Geometry
Mathematics	Algebra II	Algebra II	5 MC	Algebra II
Reading	Reading Grades 3–5	Kindergarten	1 passage*	3
Reading	Reading Grades 3–5	1	1 passage*	3
Reading	Reading Grades 3–5	2	1 passage*	3
Reading	Reading Grades 3–5	3	1 passage*	3,4
Reading	Reading Grades 3–5	4	1 passage*	4,5
Reading	Reading Grades 3–5	5	1 passage*	5,6
Reading	Reading/Lit Grades 6–HS	6	1 passage*	6,7
Reading	Reading/Lit Grades 6–HS	7	1 passage*	7, 8
Reading	Reading/Lit Grades 6–HS	8	1 passage*	8, 9+
Reading	Reading/Lit Grades 6–HS	Literature	1 passage*	9+
Science	Science Grades 3–5	2	5 MC	3
Science	Science Grades 3–5	3	5 MC	3,4
Science	Science Grades 3–5	4	5 MC	4,5
Science	Science Grades 3–5	5	5 MC	5,6
Science	Science Grades 6–HS	6	5 MC	6,7
Science	Science Grades 6–HS	7	5 MC	7, 8
Science	Science Grades 6–HS	8	5 MC	8, 9+
Science	Biology	Biology	5 MC	Biology
Science	Chemistry	Chemistry	5 MC	Chemistry

Table 6–14 (continued). Fall 2018 Embedded Field Test Design

Content Area	CDT	Item Grade/Course	Number of Items Embedded	Student Test Grade(s)
Writing	Writing Grades 3–5	Kindergarten	5 MC	3
Writing	Writing Grades 3–5	1	5 MC	3
Writing	Writing Grades 3–5	2	5 MC	3
Writing	Writing Grades 3–5	3	5 MC	3,4
Writing	Writing Grades 3–5	4	5 MC	4,5
Writing	Writing Grades 3–5	5	5 MC	5,6
Writing	Writing/Eng Comp Gr 6–HS	6	5 MC	6,7
Writing	Writing/Eng Comp Gr 6–HS	7	5 MC	7, 8
Writing	Writing/Eng Comp Gr 6–HS	8	5 MC	8, 9+
Writing	Writing/Eng Comp Gr 6–HS	English Composition	5 MC	9+

* FT reading passages include four to six items total with up to one evidence-based selected-response item.

FALL 2019—SCIENCE

The embedded field test administered in fall 2019 was designed to field test new technology-enhanced (TE) items in the science content area.

Table 6–15. Fall 2019 Embedded Field Test Item Pools

Content Area	Item Grade/Course	Number of MC Items	Number of TE Items	Total Number of Items
Science	K-2 grade span	0	0	0
Science	3	0	19	19
Science	4	0	22	22
Science	5	0	20	20
Science	6	0	18	18
Science	7	0	19	19
Science	8	0	20	20
Science	Biology	0	40	40
Science	Chemistry	0	0	0

Starting on August 19, 2019, CDTs in the science content area except Chemistry included embedded field-test items:

- Students using grade level tests took 2 field-test items. Since testing occurred throughout the year, items were given to students whose grade matched the item's grade and to students one grade above the item's grade (e.g., grade 7 items were given to students in grades 7 and 8).
- Students using CDT Biology took 2 field-test items from the Biology course.

In all cases, students did not know which items were operational and which were field test. Field test items did not count in calculation of total or diagnostic category scores.

Table 6–16. Fall 2019 Embedded Field Test Design

Content Area	CDT	Item Grade/Course	Number of Items Embedded	Student Test Grade(s)
Science	Science Grades 3–5	3	2	3, 4
Science	Science Grades 3–5	4	2	4, 5
Science	Science Grades 3–5	5	2	5, 6
Science	Science Grades 6–HS	6	2	6, 7
Science	Science Grades 6–HS	7	2	7, 8
Science	Science Grades 6–HS	8	2	8, 9+
Science	Biology	Biology	2	Biology

STATISTICAL ANALYSIS OF ITEM DATA

All field-tested items were analyzed statistically following conventional item analysis methods. For MC items, traditional or classical item statistics included the point-biserial correlation (Pt. Bis.) for the correct and incorrect responses (distractors), percent correct (p-value), and the percent selecting each incorrect response. For EBSR and TE items, the statistical indices included the item-test correlation, the point-biserial correlation for each score category, and the percent in each score category.

In general, more capable students are expected to respond correctly to easy items and less capable students are expected to respond incorrectly to difficult items. If either of these situations does not occur, the item will be reviewed by DRC test development staff and committees of Pennsylvania educators to determine the nature of the potential problem and the characteristics of the students affected. The primary way of detecting such conditions is through the point-biserial correlation coefficient for MC items and the item-test correlation for EBSR and TE items. In each case the statistic will be positive if the total-test mean score is higher for the students who respond correctly to MC items or attain a higher EBSR or TE score and negative when the reverse is true.

Item statistics are used as a means of detecting items that deserve closer scrutiny rather than as a mechanism for automatic retention or rejection. Toward this end, a set of criteria was used as a screening tool to identify items needing a closer review by committees of Pennsylvania educators.

For an MC item to be flagged, the criteria included any of the following:

- Point-biserial correlation for the correct response of less than 0.10
- Point-biserial correlation for any incorrect response greater than the point-biserial correlation for the correct response
- Differential item functioning (DIF) code of either C- or C+[2]

For an EBSR item to be flagged, the criteria included any of the following:

- Part One point-biserial correlation for the correct response of less than 0.10
- Part One point-biserial correlation for any incorrect response greater than the point-biserial correlation for the correct response
- Score proportion less than 0.05
- Differential item functioning (DIF) code of either C- or C+

[2] Items classified as C+ or C- have strong evidence of DIF. The plus sign indicates that the item favors the focal group (female or black or Hispanic) and a minus sign indicates that the item favors the reference group (male or white). For more details, see the section in this chapter on Differential Item Functioning.

For a TE item to be flagged, the criteria included any of the following:

- Item-test correlation less than 0.20
- Score proportion less than 0.05
- Differential item function (DIF) code of either C- or C+

These criteria differ slightly from the criteria used for end-of-year/course summative tests such as the Pennsylvania System of School Assessment (PSSA) or the Keystone Exams. For example, CDT items are not flagged for low and high *p*-values. While very easy and very difficult items may not be appropriate for summative tests, they are needed in diagnostic item pools so the computer adaptive item selection routine can find appropriate items for students at various levels.

Item analysis results for all items field tested prior to 2018-19 can be found in Appendix B of the 2017-2018 technical report. For field tests in 2018 or later, item analysis results are in Appendix B of the corresponding year's technical report.

REVIEW OF ITEMS WITH DATA

In the preceding section on Statistical Analysis of Item Data, it was stated that content-area test development specialists used certain statistics from item and DIF analyses of the field tests to identify items for further review. Specific flagging criteria for this purpose were specified in the previous section. Items not identified for this review were those that had good statistical characteristics and, consequently, were regarded as statistically acceptable, or had extremely poor statistical quality and, consequently were regarded as unacceptable, were removed from the CDT item pools, and needed no further review. However, there were some items that DRC content-area test development specialists and DRC psychometric specialists regarded as needing further review by committees of Pennsylvania educators.

There were separate meetings to review items with data for each field-test event and content area. CDT mathematics items from the spring 2010 stand-alone field test were reviewed by fourteen Pennsylvania educators on August 9, 2010. CDT reading and science items from the fall 2010 stand-alone field test were reviewed by sixteen and fourteen Pennsylvania educators respectively on January 24, 2011. CDT writing items from the spring 2011 stand-alone field test were reviewed by fourteen Pennsylvania educators on August 1, 2011. CDT mathematics and reading items from the spring 2013 embedded field test were reviewed by twenty-two educators respectively on July 16–18, 2013. CDT mathematics, reading, science, and writing items from both the stand-alone and embedded field tests of fall 2013 were reviewed by seven, seven, seven, and eight Pennsylvania educators respectively on January 21–23, 2014. CDT mathematics, reading, science, and writing items from the embedded field tests of fall 2015 were reviewed by 10 Pennsylvania educators for each content group on June 9–10, 2016. CDT mathematics, reading, science, and writing items from the embedded field tests of fall 2018 were reviewed by 10 Pennsylvania educators for each content group on March 26–29, 2019. CDT science technology enhanced items from the embedded field tests in 2019 were reviewed by nine Pennsylvania educators on May 20–21, 2020.

At each of the item data review meetings committee members were first trained with regard to the statistical indices used in item evaluation. This was followed by a discussion with examples concerning reasons that an item might be retained regardless of the statistics. The committee review process involved a brief exploration of possible reasons for the statistical profile of an item (e.g., possible sensitivity/bias, grade appropriateness, instructional issues) and a decision regarding acceptance. DRC content-area test development specialists facilitated the review of the items. Each committee reviewed the pool of field-test items and made recommendations (i.e., accept or reject) for each item.

Table 6–17a. CDT Data Review Results for Mathematics in August 2010

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
3	86	4	4.7%	0	0.0%	0	0.0%
4	86	7	8.1%	0	0.0%	0	0.0%
5	85	0	0.0%	0	0.0%	0	0.0%
6	259	6	2.3%	0	0.0%	0	0.0%
7	258	19	7.4%	1	0.4%	1	0.4%
8	257	20	7.8%	1	0.4%	1	0.4%
11	149	13	8.7%	0	0.0%	0	0.0%
Algebra I	256	19	7.4%	6	2.3%	6	2.3%
Geometry	257	12	4.7%	3	1.2%	19	7.4%
Algebra II	256	15	5.9%	1	0.4%	2	0.8%

*Data Review Committee, PDE, and DRC

Table 6–17b. CDT Data Review Results for Reading in January 2011

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
3	86	0	0.0%	0	0.0%	0	0.0%
4	87	2	2.3%	0	0.0%	0	0.0%
5	86	3	3.5%	0	0.0%	0	0.0%
6	210	13	6.2%	1	0.5%	4	1.9%
7	192	8	4.2%	1	0.5%	2	1.0%
8	192	3	1.6%	0	0.0%	2	1.0%
Literature	348	16	4.6%	1	0.3%	8	2.3%

*Data Review Committee, PDE, and DRC

Table 6–17c. CDT Data Review Results for Science in January 2011

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
3	91	4	4.4%	1	1.1%	5	5.5%
4	123	6	4.9%	6	4.9%	9	7.3%
5	102	8	7.8%	3	2.9%	4	3.9%
6	178	13	7.3%	4	2.2%	10	5.6%
7	327	34	10.4%	28	8.6%	64	19.6%
8	377	43	11.4%	33	8.8%	56	14.9%
11	115	26	22.6%	9	7.8%	29	25.2%
Biology	390	43	11.0%	4	1.0%	61	15.6%
Chemistry	335	33	9.9%	8	2.4%	13	3.9%

*Data Review Committee, PDE, and DRC

Table 6–17d. CDT Data Review Results for Writing in August 2011

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
3	140	4	2.9%	1	0.7%	1	0.7%
4	149	10	6.7%	1	0.7%	1	0.7%
5	165	11	6.7%	4	2.4%	4	2.4%
6	193	13	6.7%	5	2.6%	5	2.6%
7	176	16	9.1%	5	2.8%	5	2.8%
8	195	21	10.8%	2	1.0%	2	1.0%
Eng. Comp	365	28	7.7%	10	2.7%	10	2.7%

*Data Review Committee, PDE, and DRC

Table 6–17e. CDT Data Review Results for Mathematics in July 2013

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
6	156	27	17.3%	7	4.5%	7	4.5%
7	73	15	20.5%	2	2.7%	2	2.7%
8	157	39	24.8%	4	2.5%	4	2.5%

*Data Review Committee, PDE, and DRC

Table 6–17f. CDT Data Review Results for Reading in July 2013

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
6	56	1	1.8%	1	1.8%	2	3.6%
7	58	4	6.9%	3	5.2%	4	6.9%
8	57	2	3.5%	1	1.8%	1	1.8%

*Data Review Committee, PDE, and DRC

Table 6–17g. CDT Data Review Results for Mathematics in January 2014

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
K	60	14	23.3%	0	0.0%	1	1.7%
1	90	15	16.7%	0	0.0%	0	0.0%
2	130	11	8.5%	4	3.1%	5	3.8%
3	235	31	13.2%	3	1.3%	6	2.6%
4	248	20	8.1%	4	1.6%	11	4.4%
5	221	21	9.5%	4	1.8%	10	4.5%

*Data Review Committee, PDE, and DRC

Table 6–17h. CDT Data Review Results for Reading in January 2014

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
K	84	11	13.1%	0	0.0%	0	0.0%
1	98	8	8.2%	3	3.1%	3	3.1%
2	98	1	1.0%	0	0.0%	0	0.0%
3	178	17	9.6%	2	1.1%	2	1.1%
4	189	11	5.8%	2	1.1%	2	1.1%
5	134	15	11.2%	0	0.0%	0	0.0%

*Data Review Committee, PDE, and DRC

Table 6–17i. CDT Data Review Results for Science in January 2014

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
K–2	280	31	11.1%	5	1.8%	9	3.2%
3	155	9	5.8%	1	0.6%	4	2.6%
4	213	23	10.8%	4	1.9%	13	6.1%
5	152	44	28.9%	7	4.6%	10	6.6%

*Data Review Committee, PDE, and DRC

Table 6–17j. CDT Data Review Results for Writing in January 2014

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
K	44	13	29.5%	2	4.5%	2	4.5%
1	118	18	15.3%	6	5.1%	6	5.1%
2	117	7	6.0%	3	2.6%	4	3.4%
3	60	4	6.7%	2	3.3%	2	3.3%
4	60	10	16.7%	3	5.0%	3	5.0%
5	71	15	21.1%	6	8.5%	6	8.5%

*Data Review Committee, PDE, and DRC

Table 6–17k. CDT Data Review Results for Mathematics in June 2016

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
6	122	17	13.9%	4	3.3%	4	3.3%
7	177	41	23.3%	10	5.7%	11	6.3%
8	151	31	20.4%	3	2.0%	4	2.6%
Algebra I	150	28	18.7%	1	0.7%	2	1.3%

*Data Review Committee, PDE, and DRC

Table 6–17l. CDT Data Review Results for Reading in June 2016

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
3	22	5	22.7%	0	0.0%	0	0.0%
4	22	6	27.3%	1	4.5%	1	4.5%
5	22	3	13.6%	0	0.0%	1	4.5%
6	126	10	7.9%	1	0.8%	4	3.2%
7	126	10	7.9%	1	0.8%	1	0.8%
8	126	12	9.5%	1	0.8%	3	2.4%
Literature	126	14	11.1%	1	0.8%	2	1.6%

*Data Review Committee, PDE, and DRC

Table 6–17m. CDT Data Review Results for Science in June 2016

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
6	72	12	16.7%	5	6.9%	6	8.3%
7	159	35	22.0%	6	3.8%	6	3.8%
8	238	65	27.3%	12	5.0%	12	5.0%
Biology	136	15	11.0%	1	0.7%	1	0.7%

*Data Review Committee, PDE, and DRC

Table 6–17n. CDT Data Review Results for Writing in June 2016

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
6	93	10	10.8%	3	3.2%	3	3.2%
7	93	9	9.7%	1	1.1%	1	1.1%
8	110	13	11.8%	3	2.7%	4	3.6%
Eng. Comp	104	12	11.5%	2	1.9%	2	1.9%

*Data Review Committee, PDE, and DRC

Table 6–17o. CDT Data Review Results for Mathematics in March 2019

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
K-2	60	7	11.7%	0	0.0%	0	0.0%
3	178	21	11.8%	6	3.4%	6	3.4%
4	179	12	6.7%	1	0.6%	1	0.6%
5	180	8	4.4%	0	0.0%	0	0.0%
6	96	4	4.2%	1	1.0%	1	1.0%
7	103	10	9.7%	2	1.9%	2	1.9%
8	99	18	18.2%	4	4.0%	4	4.0%
Algebra I	299	64	21.4%	11	3.6%	11	3.6%
Geometry	100	22	22.0%	1	1.0%	1	1.0%
Algebra II	100	27	27.0%	2	2.0%	2	2.0%

*Data Review Committee, PDE, and DRC

Table 6–17p. CDT Data Review Results for Reading in March 2019

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
K-2	84	10	11.9%	4	4.8%	4	4.8%
3	162	18	11.1%	4	2.5%	4	2.5%
4	162	16	10.5%	3	1.9%	4	2.5%
5	162	22	14.2%	5	3.1%	6	3.7%
6	123	10	8.1%	1	0.8%	1	0.8%
7	123	10	8.1%	4	3.3%	4	3.3%
8	120	14	11.7%	3	2.5%	3	2.5%
Literature	249	28	11.2%	2	0.8%	2	0.8%

*Data Review Committee, PDE, and DRC

Table 6–17q. CDT Data Review Results for Science in March 2019

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
2	31	4	12.9%	1	3.2%	1	3.2%
3	89	10	11.2%	2	2.2%	2	2.2%
4	95	14	14.7%	2	2.1%	2	2.1%
5	90	21	23.3%	2	2.2%	2	2.2%
6	97	25	25.8%	6	6.2%	6	6.2%
7	99	14	14.1%	1	1.0%	1	1.0%
8	102	24	23.5%	9	8.8%	9	8.8%
Biology	290	50	17.2%	11	3.8%	11	3.8%
Chemistry	100	49	49.0%	1	1.0%	1	1.0%

*Data Review Committee, PDE, and DRC

Table 6–17r. CDT Data Review Results for Writing in March 2019

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
K-2	32	4	12.5%	1	3.1%	3	9.4%
3	99	11	11.1%	1	1.0%	1	1.0%
4	90	7	7.8%	1	1.1%	2	2.2%
5	90	11	12.2%	1	1.1%	1	1.1%
6	93	9	9.7%	1	1.1%	2	2.2%
7	111	12	10.8%	1	0.9%	1	0.9%
8	93	10	10.8%	1	1.1%	1	1.1%
Eng. Comp	294	72	24.5%	18	6.1%	18	6.1%

*Data Review Committee, PDE, and DRC

Table 6–17s. CDT Data Review Results for Science in May 2020

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
3	19	4	21.1%	2	10.53%	2	10.5%
4	22	9	40.9%	4	18.18%	5	22.7%
5	20	6	30.0%	1	5.00%	3	15.0%
6	18	4	22.2%	1	5.56%	1	5.6%
7	19	4	21.1%	3	15.79%	3	15.8%
8	20	7	35.0%	2	10.00%	2	10.0%
Biology	40	6	15.0%	3	7.50%	3	7.5%

*Data Review Committee, PDE, and DRC

DIFFERENTIAL ITEM FUNCTIONING

Differential item functioning (DIF) occurs when examinees with the same ability level but different group memberships do not have the same probability of answering an item correctly. This pattern of results may suggest the presence of item bias. As a statistical concept, however, DIF can be differentiated from item sensitivity/bias, which is a content issue that can arise when an item presents negative group stereotypes, uses language that is more familiar to one subpopulation than to another, or is presented in a format that disadvantages certain learning styles. While the source of item sensitivity/bias is often easily recognized by trained judges, DIF may have no clear cause. However, studying how DIF arises and how it presents itself can help to detect and correct for it.

LIMITATIONS OF STATISTICAL DETECTION

No statistical procedure should be used as a substitute for rigorous, hands-on reviews by content and bias specialists. The statistical results can help organize the review so the effort is concentrated on the most problematic cases. Further, no items should be automatically rejected simply because a statistical method flagged them or accepted because they were not flagged.

Statistical detection of DIF is an inexact science. There have been a variety of methods proposed for detecting DIF, but no one statistic can be considered either necessary or sufficient. Different methods are more or less successful depending on the situation. No analysis can guarantee that a test is free of bias, but almost any thoughtful analysis will uncover the most flagrant problems.

A fundamental shortcoming of all statistical methods used in DIF evaluation is that all are intrinsic to the test being evaluated. If a test is unbiased overall but contains one or two DIF items, any method will locate the problems. If, however, all items on the test show consistent DIF to the disadvantage of a given subpopulation, a statistical analysis of the items will not be able to separate DIF effects from true differences in achievement.

MANTEL-HAENSZEL PROCEDURE OF DIFFERENTIAL ITEM FUNCTIONING

For MC items, the Mantel-Haenszel (MH) procedure (Mantel & Haenszel, 1959) for detecting differential item functioning is a commonly used technique in educational testing. It does not depend on the application or the fit of any specific measurement model. However, it does have significant philosophical overlap with the Rasch model since it uses a test's total score to organize the analysis.

The procedure as implemented by DRC contrasts a focal group with a reference group. While it makes no practical difference in the analysis which group is defined as the focal group, the group most apt to be disadvantaged by a biased measurement is typically defined as the focal group. In these analyses, the focal group was female for gender-based DIF and black or Hispanic[3] for ethnicity-based DIF; reference groups were male and white respectively. The MH statistic for each item is computed from a contingency table. It has two groups (focal and reference) and two outcomes (right or wrong). The ability groups are defined by the test's score distribution for the total examinee population.

The basic MH statistic is a single degree of freedom chi-square that compares the observed number in each cell to the expected number. The expected counts are computed to ensure that the analysis is not confounded with differences in the achievement level of the two groups.

For EBSR and TE items, a comparable statistic is computed based on the standardized mean difference (SMD) (Dorans, Schmitt, & Bleistein, 1992), which is computed as the differences in mean scores for the focal and reference groups if both groups had the same score distribution.

To assist the review committees in interpreting the analyses, the items are assigned a severity code based on the magnitude of the DIF statistic. Items classified as A+ or A- have little or no statistical indication of DIF. Items classified as B+ or B- have some indication of DIF but may be judged to be acceptable for future use. Items classified as C+ or C- have strong evidence of DIF and should be reviewed and possibly rejected from the eligible item pool. The plus sign indicates that the item favors the focal group and a minus sign indicates that the item favors the reference group.

[3] Based on the population of CDT testers, ethnicity DIF on the white/Hispanic pairing was not run prior to 2018.

RESULTS AND OBSERVATIONS

Counts of the number of items field tested from each content area and grade/course that were assigned to each severity code are shown in Table 6–18. Some field-test items are classified as N/A (not applicable) because the number of students in either the reference or focal groups who took the item was insufficient for analysis. Where there are sufficient data to run DIF analyses, relatively few items had B or C DIF for the Male/Female, White/Black, or White/Hispanic reference and focal groups.

Table 6–18a. DIF Summary for Mathematics in August 2010

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*	White/Black A+	White/Black A-	White/Black B+	White/Black B-	White/Black C+	White/Black C-	White/Black N/A*
3	86	49	22	12	1	1	1	0	25	44	3	12	0	2	0
4	86	40	31	7	5	0	3	0	31	33	3	10	0	3	6
5	85	42	36	5	2	0	0	0	19	54	2	10	0	0	0
6	259	121	112	14	8	3	1	0	79	143	8	27	0	2	0
7	258	109	112	18	9	4	6	0	88	124	13	20	0	2	11
8	257	101	104	31	15	5	1	0	62	65	7	14	0	0	109
11	149	53	75	4	11	0	6	0	20	41	1	8	0	1	78
Algebra I	256	122	120	7	6	1	0	0	107	110	9	11	1	3	15
Geometry	257	115	123	7	8	1	3	0	93	109	6	15	1	2	31
Algebra II	256	124	115	6	9	0	2	0	58	89	4	14	2	4	85

N/A* Items with insufficient counts for DIF analysis
The plus sign indicates that the item favors the focal group (female or black) and a minus sign indicates that the item favors the reference group (male or white).

Table 6–18b. DIF Summary for Reading in January 2011

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*	White/Black A+	White/Black A-	White/Black B+	White/Black B-	White/Black C+	White/Black C-	White/Black N/A*
3	86	41	34	5	6	0	0	0	26	31	2	6	0	0	21
4	87	47	37	1	1	0	1	0	21	45	1	7	1	0	12
5	86	47	27	9	2	1	0	0	28	45	4	7	1	1	0
6	210	103	87	7	10	0	3	0	72	100	7	25	1	5	0
7	192	90	78	9	11	2	2	0	69	68	4	11	1	2	37
8	192	109	67	10	6	0	0	0	22	34	2	6	0	1	127
Literature	348	147	146	21	25	3	6	0	5	5	0	0	0	0	338

N/A* Items with insufficient counts for DIF analysis
The plus sign indicates that the item favors the focal group (female or black) and a minus sign indicates that the item favors the reference group (male or white).

Table 6–18c. DIF Summary for Science in January 2011

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*	White/Black A+	White/Black A-	White/Black B+	White/Black B-	White/Black C+	White/Black C-	White/Black N/A*
3	91	47	41	1	2	0	0	0	20	29	2	4	0	3	33
4	123	55	53	6	5	3	1	0	15	22	1	5	0	1	79
5	102	48	45	4	2	2	1	0	25	36	3	4	0	0	34
6	178	80	84	4	7	1	2	0	10	11	1	1	0	0	155
7	327	123	143	28	27	2	4	0	58	56	2	15	0	0	196
8	377	155	154	28	32	3	5	0	5	6	0	0	0	1	365
11	115	47	49	4	12	1	2	0	0	0	0	0	0	0	115
Biology	390	154	183	22	23	2	6	0	4	6	0	0	0	0	380
Chemistry	335	143	148	17	21	2	4	0	6	4	2	0	0	0	323

N/A* Items with insufficient counts for DIF analysis
The plus sign indicates that the item favors the focal group (female or black) and a minus sign indicates that the item favors the reference group (male or white).

Table 6–18d. DIF Summary for Writing in August 2011

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*	White/Black A+	White/Black A-	White/Black B+	White/Black B-	White/Black C+	White/Black C-	White/Black N/A*
3	140	71	59	4	4	1	1	0	24	44	3	4	0	0	65
4	149	69	67	7	5	1	0	0	15	26	3	2	0	0	103
5	165	78	62	15	7	3	0	0	12	14	1	2	0	1	135
6	193	94	82	8	7	1	1	0	53	67	4	12	0	4	53
7	176	73	81	16	3	3	0	0	11	20	1	3	0	0	141
8	195	95	81	10	3	3	3	0	4	3	0	2	0	1	185
Eng Comp	365	157	155	29	18	4	2	0	3	5	1	0	0	1	355

N/A* Items with insufficient counts for DIF analysis
The plus sign indicates that the item favors the focal group (female or black) and a minus sign indicates that the item favors the reference group (male or white).

Table 6–18e. DIF Summary for Mathematics in July 2013

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*	White/Black A+	White/Black A-	White/Black B+	White/Black B-	White/Black C+	White/Black C-	White/Black N/A*
3	56	0	0	0	0	0	0	56	0	0	0	0	0	0	56
4	67	0	0	0	0	0	0	67	0	0	0	0	0	0	67
5	41	0	0	0	0	0	0	41	0	0	0	0	0	0	41
6	156	67	65	9	14	1	0	0	2	1	0	2	0	0	151
7	73	37	32	2	1	0	1	0	13	16	1	4	0	0	39
8	157	72	63	8	12	2	0	0	2	5	0	1	0	0	149

N/A* Items with insufficient counts for DIF analysis or those that were re-field tested in fall 2013.
The plus sign indicates that the item favors the focal group (female or black) and a minus sign indicates that the item favors the reference group (male or white).

Table 6–18f. DIF Summary for Reading in July 2013

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*	White/Black A+	White/Black A-	White/Black B+	White/Black B-	White/Black C+	White/Black C-	White/Black N/A*
3	58	0	0	0	0	0	0	58	0	0	0	0	0	0	58
4	71	0	0	0	0	0	0	71	0	0	0	0	0	0	71
5	60	0	0	0	0	0	0	60	0	0	0	0	0	0	60
6	56	29	21	4	2	0	0	0	4	6	0	2	0	0	44
7	58	29	21	4	3	1	0	0	11	34	1	3	0	0	9
8	57	34	20	2	1	0	0	0	13	38	0	5	0	1	0

N/A* Items with insufficient counts for DIF analysis or those that were re-field tested in fall 2013.
The plus sign indicates that the item favors the focal group (female or black) and a minus sign indicates that the item favors the reference group (male or white).

Table 6–18g. DIF Summary for Mathematics in January 2014

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*	White/Black A+	White/Black A-	White/Black B+	White/Black B-	White/Black C+	White/Black C-	White/Black N/A*
K	60	31	19	6	3	1	0	0	6	14	1	5	0	2	32
1	90	40	38	8	4	0	0	0	18	25	0	5	0	0	42
2	130	47	56	7	16	1	3	0	24	32	3	4	0	1	66
3	235	101	101	11	15	4	3	0	28	41	2	5	1	1	157
4	248	105	110	16	14	2	1	0	37	44	7	11	0	2	147
5	221	108	84	13	12	2	2	0	31	41	3	8	0	1	137

N/A* Items with insufficient counts for DIF analysis or those that were re-field tested in fall 2013.
The plus sign indicates that the item favors the focal group (female or black) and a minus sign indicates that the item favors the reference group (male or white).

Table 6–18h. DIF Summary for Reading in January 2014

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*	White/Black A+	White/Black A-	White/Black B+	White/Black B-	White/Black C+	White/Black C-	White/Black N/A*
K	84	50	21	9	2	2	0	0	9	10	0	3	0	0	62
1	98	57	31	6	3	1	0	0	7	11	0	0	0	0	80
2	98	47	43	3	4	0	1	0	5	13	0	2	0	0	78
3	178	81	75	8	10	3	1	0	54	69	5	11	0	1	38
4	189	93	78	12	6	0	0	0	40	54	2	7	0	2	84
5	134	75	49	6	2	0	2	0	23	53	1	6	0	2	49

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (female or black) and a minus sign indicates that the item favors the reference group (male or white).

Table 6–18i. DIF Summary for Science in January 2014

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*	White/Black A+	White/Black A-	White/Black B+	White/Black B-	White/Black C+	White/Black C-	White/Black N/A*
K–2	280	130	108	8	13	1	0	20	0	0	0	0	0	0	280
3	155	69	70	9	4	2	1	0	3	2	0	0	0	0	150
4	213	94	93	12	12	1	1	0	0	0	0	0	0	0	213
5	152	58	61	6	8	0	0	19	1	0	0	0	0	0	151

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (female or black) and a minus sign indicates that the item favors the reference group (male or white).

Table 6–18j. DIF Summary for Writing in January 2014

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*	White/Black A+	White/Black A-	White/Black B+	White/Black B-	White/Black C+	White/Black C-	White/Black N/A*
K	44	20	22	2	0	0	0	0	0	0	0	0	0	0	44
1	118	71	42	2	3	0	0	0	0	0	0	0	0	0	118
2	117	56	49	6	5	1	0	0	0	0	0	0	0	0	117
3	60	33	22	3	1	0	1	0	12	17	4	7	0	0	20
4	60	24	29	4	1	2	0	0	20	14	0	6	0	0	20
5	71	40	22	5	3	1	0	0	0	0	0	0	0	0	71

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (female or black) and a minus sign indicates that the item favors the reference group (male or white)

Table 6–18k. DIF Summary for Mathematics in June 2016

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*	White/Black A+	White/Black A-	White/Black B+	White/Black B-	White/Black C+	White/Black C-	White/Black N/A*
6	122	74	48	0	0	0	0	0	48	69	0	3	0	2	0
7	177	74	82	5	9	3	3	1	46	105	1	15	0	6	4
8	151	63	76	4	4	1	2	1	49	55	6	11	0	3	27
Algebra I	150	82	65	1	1	0	0	1	50	96	0	3	0	0	1

N/A* Items with insufficient counts for DIF analysis or those that were re-field tested in fall 2013.
The plus sign indicates that the item favors the focal group (female or black) and a minus sign indicates that the item favors the reference group (male or white).

Table 6–18l. DIF Summary for Reading in June 2016

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*	White/Black A+	White/Black A-	White/Black B+	White/Black B-	White/Black C+	White/Black C-	White/Black N/A*
3	22	9	10	0	2	0	0	1	2	11	0	3	0	0	6
4	22	8	7	2	0	0	1	4	3	4	1	0	0	0	14
5	22	10	8	0	0	0	0	4	4	7	0	1	0	0	10
6	126	63	56	3	0	0	1	3	42	75	0	5	0	1	3
7	126	81	37	7	1	0	0	0	48	71	0	7	0	0	0
8	126	68	52	3	1	0	0	2	44	75	0	5	0	0	2
Literature	126	68	51	5	1	0	0	1	41	82	0	2	0	0	1

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (female or black) and a minus sign indicates that the item favors the reference group (male or white).

Table 6–18m. DIF Summary for Science in June 2016

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*	White/Black A+	White/Black A-	White/Black B+	White/Black B-	White/Black C+	White/Black C-	White/Black N/A*
6	72	37	31	2	2	0	0	0	19	30	2	6	0	0	15
7	159	75	67	5	10	0	2	0	31	54	2	13	0	1	58
8	238	106	106	11	8	4	3	0	36	69	4	17	0	0	112
Biology	136	64	70	1	1	0	0	0	34	101	0	1	0	0	0

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (female or black) and a minus sign indicates that the item favors the reference group (male or white).

Table 6–18n. DIF Summary for Writing in June 2016

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*	White/Black A+	White/Black A-	White/Black B+	White/Black B-	White/Black C+	White/Black C-	White/Black N/A*
6	93	53	34	2	4	0	0	0	26	27	2	11	0	0	27
7	93	48	38	2	3	2	0	0	6	13	1	3	0	0	70
8	110	66	38	3	1	1	1	0	3	6	0	2	0	0	99
Eng Comp	104	50	40	9	3	1	1	0	0	0	0	0	0	0	104

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (female or black) and a minus sign indicates that the item favors the reference group (male or white).

Table 6–18o. Gender DIF Summary for Mathematics in March 2019

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*
K	20	10	7	2	0	1	0	0
1	20	11	6	2	0	1	0	0
2	20	9	10	0	1	0	0	0
3	178	81	79	8	5	3	2	0
4	179	83	82	7	6	1	0	0
5	180	96	71	7	3	3	0	0
6	96	51	40	2	3	0	0	0
7	103	42	53	4	4	0	0	0
8	99	52	41	1	4	0	1	0
Algebra I	299	157	131	2	8	0	1	0
Geometry	100	43	50	4	3	0	0	0
Algebra II	100	45	43	6	4	0	2	0

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (female) and a minus sign indicates that the item favors the reference group (male).

Table 6–18p. Ethnicity DIF Summary for Mathematics in March 2019

Grade/ Course	Number of Field-test items	White/ Black A+	White/ Black A-	White/ Black B+	White/ Black B-	White/ Black C+	White/ Black C-	White/ Black N/A*	White/ Hispanic A+	White/ Hispanic A-	White/ Hispanic B+	White/ Hispanic B-	White/ Hispanic C+	White/ Hispanic C-	White/ Hispanic N/A*
K	20	2	11	0	3	0	0	4	2	11	0	6	0	1	0
1	20	8	8	0	3	0	0	1	6	11	0	3	0	0	0
2	20	6	7	0	2	0	2	3	4	11	0	4	0	1	0
3	178	47	93	2	22	0	4	10	46	102	5	16	0	8	1
4	179	54	92	3	20	0	2	8	62	93	2	15	0	6	1
5	180	61	97	1	19	0	1	1	68	101	1	8	0	1	1
6	96	28	59	0	9	0	0	0	31	64	1	0	0	0	0
7	103	35	57	0	10	0	1	0	29	62	1	9	0	2	0
8	99	43	47	1	5	0	0	3	42	54	0	2	0	0	1
Algebra I	299	114	169	2	11	0	3	0	112	172	2	12	0	1	0
Geometry	100	14	18	1	3	0	0	64	7	4	0	0	0	0	89
Algebra II	100	8	7	1	0	0	0	84	2	3	0	0	0	0	95

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (black or Hispanic) and a minus sign indicates that the item favors the reference group (white).

Table 6–18q. Gender DIF Summary for Reading in March 2019

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*
K	32	19	9	3	0	1	0	0
1	20	9	8	2	0	1	0	0
2	32	18	12	0	2	0	0	0
3	162	73	86	0	3	0	0	0
4	162	86	75	0	0	0	1	0
5	162	98	60	4	0	0	0	0
6	123	74	38	8	2	0	1	0
7	123	81	37	2	2	0	1	0
8	120	77	42	0	1	0	0	0
Literature	249	152	93	3	1	0	0	0

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (female) and a minus sign indicates that the item favors the reference group (male).

Table 6–18r. Ethnicity DIF Summary for Reading in March 2019

Grade/ Course	Number of Field-test items	White/ Black A+	White/ Black A-	White/ Black B+	White/ Black B-	White/ Black C+	White/ Black C-	White/ Black N/A*	White/ Hispanic A+	White/ Hispanic A-	White/ Hispanic B+	White/ Hispanic B-	White/ Hispanic C+	White/ Hispanic C-	White/ Hispanic N/A*
K	32	4	12	0	0	0	0	16	10	15	0	3	0	0	32
1	20	1	5	1	0	0	1	12	9	10	0	1	0	0	20
2	32	10	10	0	3	0	1	8	12	17	1	2	0	0	32
3	162	58	82	2	10	2	2	6	51	95	4	11	0	1	162
4	162	62	78	2	10	1	3	6	68	79	0	13	1	1	162
5	162	64	76	3	7	0	0	12	54	100	2	4	0	2	162
6	123	47	70	2	4	0	0	0	47	69	3	4	0	0	123
7	123	43	72	3	5	0	0	0	53	64	3	3	0	0	123
8	120	41	72	0	6	0	1	0	40	76	0	4	0	0	120
Literature	249	103	131	1	11	0	3	0	97	140	2	9	0	1	249

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (black or Hispanic) and a minus sign indicates that the item favors the reference group (white).

Table 6–18s. Gender DIF Summary for Science in March 2019

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*
2	31	10	19	0	1	0	1	0
3	89	42	41	5	1	0	0	0
4	95	46	43	4	2	0	0	0
5	90	42	41	6	0	0	1	0
6	97	45	42	5	3	1	1	0
7	99	45	52	1	0	1	0	0
8	102	48	50	1	2	0	1	0
Biology	290	145	140	2	3	0	0	0
Chemistry	100	41	45	5	6	3	0	0

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (female) and a minus sign indicates that the item favors the reference group (male).

Table 6–18t. Ethnicity DIF Summary for Science in March 2019

Grade/ Course	Number of Field-test items	White/ Black A+	White/ Black A-	White/ Black B+	White/ Black B-	White/ Black C+	White/ Black C-	White/ Black N/A*	White/ Hispanic A+	White/ Hispanic A-	White/ Hispanic B+	White/ Hispanic B-	White/ Hispanic C+	White/ Hispanic C-	White/ Hispanic N/A*
2	31	8	7	0	1	0	0	15	0	0	0	0	0	0	31
3	89	32	49	4	3	0	1	0	27	50	1	10	0	0	1
4	95	35	46	5	6	0	0	3	37	52	2	3	0	1	0
5	90	14	43	5	5	0	1	22	29	43	2	10	0	2	4
6	97	24	44	2	5	0	3	19	31	56	0	7	0	1	2
7	99	26	58	2	7	0	2	4	39	49	2	7	1	0	1
8	102	29	50	2	9	0	3	9	32	60	4	4	0	2	0
Biology	290	108	168	1	10	0	3	0	95	184	1	10	0	0	0
Chemistry	100	0	0	0	0	0	0	100	2	4	0	0	0	0	94

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (black or Hispanic) and a minus sign indicates that the item favors the reference group (white).

Table 6–18u. Gender DIF Summary for Writing in March 2019

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*
K	10	5	5	0	0	0	0	0
1	10	4	5	1	0	0	0	0
2	12	5	6	0	0	1	0	0
3	99	50	38	8	1	1	1	0
4	90	45	32	8	3	1	1	0
5	90	46	29	8	2	3	2	0
6	93	48	32	7	2	3	1	0
7	111	56	37	7	7	4	0	0
8	93	51	31	7	4	0	0	0
Eng Comp	294	64	43	5	1	0	1	180

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (female) and a minus sign indicates that the item favors the reference group (male).

Table 6–18v. Ethnicity DIF Summary for Writing in March 2019

Grade/ Course	Number of Field-test items	White/ Black A+	White/ Black A-	White/ Black B+	White/ Black B-	White/ Black C+	White/ Black C-	White/ Black N/A*	White/ Hispanic A+	White/ Hispanic A-	White/ Hispanic B+	White/ Hispanic B-	White/ Hispanic C+	White/ Hispanic C-	White/ Hispanic N/A*
K	10	0	0	0	0	0	0	10	0	0	0	0	0	0	10
1	10	0	0	0	0	0	0	10	0	0	0	0	0	0	10
2	12	0	0	0	0	0	0	12	0	0	0	0	0	0	12
3	99	0	0	0	0	0	0	99	0	0	0	0	0	0	99
4	90	0	0	0	0	0	0	90	0	0	0	0	0	0	90
5	90	0	1	0	0	0	0	89	1	0	0	0	0	0	89
6	93	2	6	0	0	0	0	85	0	1	0	0	0	0	92
7	111	3	5	0	0	0	0	103	2	1	0	0	0	0	108
8	93	0	0	0	0	0	0	93	0	0	0	0	0	0	93
Eng Comp	294	0	0	0	0	0	0	294	0	0	0	0	0	0	294

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (black or Hispanic) and a minus sign indicates that the item favors the reference group (white).

Table 6–18w. Gender DIF Summary for Science in May 2020

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*
3	19	7	11	1	0	0	0	0
4	22	9	11	0	2	0	0	0
5	20	5	14	1	0	0	0	0
6	18	6	10	0	2	0	0	0
7	19	12	6	0	1	0	0	0
8	20	8	11	0	1	0	0	0
Biology	40	18	21	0	1	0	0	0

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (female) and a minus sign indicates that the item favors the reference group (male).

Table 6–18x. Ethnicity DIF Summary for Science in May 2019

Grade/ Course	Number of Field-test items	White/ Black A+	White/ Black A-	White/ Black B+	White/ Black B-	White/ Black C+	White/ Black C-	White/ Black N/A*	White/ Hispanic A+	White/ Hispanic A-	White/ Hispanic B+	White/ Hispanic B-	White/ Hispanic C+	White/ Hispanic C-	White/ Hispanic N/A*
3	19	4	10	0	3	0	2	0	4	12	0	2	0	1	0
4	22	7	10	2	1	1	1	0	5	13	0	3	0	1	0
5	20	5	9	0	5	0	0	1	4	15	0	0	0	1	0
6	18	1	16	0	1	0	0	0	1	16	0	1	0	0	0
7	19	2	15	0	2	0	0	0	4	14	0	1	0	0	0
8	20	2	17	0	0	0	1	0	5	13	0	1	0	1	0
Biology	40	8	30	0	2	0	0	0	9	30	0	1	0	0	0

N/A* Items with insufficient counts for DIF analysis.
The plus sign indicates that the item favors the focal group (black or Hispanic) and a minus sign indicates that the item favors the reference group (white).

CHAPTER SEVEN: CLASSICAL ITEM STATISTICS

This chapter provides an overview of the two most familiar item-level statistics obtained from classical (traditional) item analysis: item difficulty and item discrimination. The following results pertain to all items field tested in the stand-alone and embedded field-test events. Other statistics such as Rasch item statistics are discussed in Chapter Eight.

ITEM-LEVEL STATISTICS

Classical item statistics for all items field tested prior to 2018–2019 can be found in Appendix B of the 2017–2018 technical report. Classical item statistics for items field tested in 2018–2019 or later can be found in Appendix B of the corresponding year's technical report. In all versions of appendix B, results are organized by content area, field-test event, and item type (multiple-choice, evidence-based selected-response, and technology-enhanced). These statistics represent the item characteristics most often used to determine whether an item functioned properly and/or how a group of students performed on a particular item. The item statistics in Appendix B include:

- Number of students taking the item (denoted as *N*)
- Indicators of item difficulty (denoted as PVal)
  - *p*-values for multiple-choice (MC) items
  - item mean divided by maximum possible item score for evidence-based selected-response (EBSR) and technology-enhanced (TE) items
- Proportions by response option or score point
  - proportions of students who chose each response option for MC items (denoted as P(A), P(B), P(C), P(D))
  - proportions of students who gained each score point for EBSR and TE items (denoted as P(0), P(1), P(2), and/or P(3))
  - Proportions of students who did not respond to an item (denoted as P(-))
- Indicators of item discrimination
  - item-total correlations (denoted as PtBis)
  - point-biserial correlation for each response option for MC items (denoted as PT(A), PT(B), PT(C), and PT(D))
  - point-biserial correlation for each score point for EBSR and TE items (denoted as PT(0), PT(1), PT(2), and PT(3))

ITEM DIFFICULTY

At the most general level, an item's difficulty is indicated by its mean score in some specified group (e.g., grade level).

$$\bar{x} = \frac{1}{n} \cdot \sum_{i=1}^{n} x_i$$

In the mean score formula above, the individual item scores (*xi*) are summed and then divided by the total number of students (*n*). For MC items, student scores are represented by 0s and 1s (0 = wrong, 1 = right). With 0/1 scoring, the equation above also represents the number of students correctly answering the item divided by the total number of students. So, this is also the *proportion correct* for the item, or as it is better known, the *p*-value. In theory, *p*-values can range from 0.00[1] to 1.00 on the proportion-correct scale. For example, if an item has a *p*-value of 0.89, it means 89 percent of the students answered the item correctly. Additionally, this value might also suggest that the item is relatively easy and/or the students who attempted the item are relatively high achievers. In other words, item difficulty and student ability are somewhat confounded.

[1] For multiple-choice (MC) items with four response options, pure random guessing would lead to an expected *p*-value of 0.25.

For EBSR items, mean scores can range from the minimum possible score of zero to the maximum possible score of either two or three depending upon the item. Similarly, for TE items, mean scores can range from the minimum possible score of zero to the maximum possible score of either one or two depending upon the item. A *pseudo p*-value is provided for EBSR and TE items by dividing the mean item score by the maximum possible item score.

The minimum and maximum extremes of the difficulty scale are virtually never seen in applied practice. However, understanding what those values are helps illustrate that relatively lower values correspond to more difficult items and that relatively higher values correspond to easier items. (Because of this, some assert that this index would be better referred to as the item's *easiness*.)

Item difficulty is an important consideration for the Classroom Diagnostic Tools (CDT) because it is a computer adaptive test. The item selection routine selects items based on student performance during the test. While very easy or very difficult items may not be appropriate for many students, they are needed in the CDT item pools to ensure that the item selection routine can find appropriate items for students at various levels.

Utilizing the proportion of students who chose each MC option can be helpful for verifying keys. For example, if a large proportion of students chose a distractor instead of the key answer, it may, but not always, indicate the key is not correct.

ITEM DISCRIMINATION

At the most general level, item discrimination[2] indicates an item's ability to differentiate between high and low achievers. It is expected that students with high ability (i.e., those who perform well on the CDT overall) would be more likely to answer any given CDT item correctly, while students with low ability (i.e., those who perform poorly on the CDT overall) would be more likely to answer the same item incorrectly. For the CDT, Pearson's product-moment correlation coefficient between item scores and test scores is used to indicate discrimination. The correlation coefficient can range from -1.0 to +1.0. If the aforementioned expectation is met (high-scoring students tend to get the item right while low-scoring students do not), the correlation between the item score and the total test score will be both positive and noticeably large in its magnitude (i.e., well above zero), meaning the item is a good discriminator between high- and low-ability students.

Item total correlation for each option is another indicator of an item's ability to differentiate between high and low achievers. It is expected that students with high ability (i.e., those who perform well on the CDT overall) would be less likely to choose any distractors, while students with low ability (i.e., those who perform poorly on the CDT overall) would be more likely to choose a distractor. In other words, the item total correlations for the distractors are expected to be negative.

In summary, the correlation will be positive in value when the mean test score of the students answering the item correctly is higher than the mean test score of the students answering the item incorrectly.[3] In other words, this indicates that students who did well on the total test tended to do well on the item, as well. However, an interaction can exist between item discrimination and item difficulty. Items answered correctly (or incorrectly) by a large proportion of examinees (i.e., they have extreme *p*-values) can have reduced power to discriminate, and, thus, can have lower correlations.

Discrimination is an important consideration for the operational CDT because the use of more discriminating items on a test is associated with more precise score estimates (i.e., there will be smaller confidence intervals around the scores).

[2] As noted earlier, the discrimination index for dichotomous MC items is typically referred to as the *point-biserial correlation coefficient*. For EBSR and TE items, the *item-test correlation* is sometimes used.

[3] It is legitimate to view the point-biserial correlation as a standardized mean. A positive value indicates students who chose that response had a higher mean score than the average student; a negative value indicates students who chose that response had a lower-than-average mean score.

OBSERVATIONS AND INTERPRETATIONS

Table 7–1 provides the mean *p*-values and point-biserial correlations for the CDT item pools in each content area. The mean *p*-value ranged from 0.279 to 0.824. The mean point-biserial correlations ranged from 0.155 to 0.491.

It is difficult to make global conclusions about overall quality from these item statistics alone. With that caveat in mind, the results presented in this chapter indicate that the CDT item pools contain items within expected and acceptable ranges of item difficulty and discrimination.

Table 7–1. Mean *P*-value and Point-Biserial

Meeting Date	Content Area	Grade/Course	Number of Items Field Tested	Mean *P*-value	Mean Point-Biserial
Aug 2010	Mathematics	3	86	0.824	0.415
Aug 2010	Mathematics	4	86	0.737	0.414
Aug 2010	Mathematics	5	85	0.717	0.439
Aug 2010	Mathematics	6	259	0.684	0.413
Aug 2010	Mathematics	7	258	0.575	0.432
Aug 2010	Mathematics	8	257	0.497	0.361
Aug 2010	Mathematics	11	149	0.521	0.339
Aug 2010	Mathematics	Algebra I	256	0.411	0.317
Aug 2010	Mathematics	Geometry	257	0.439	0.349
Aug 2010	Mathematics	Algebra II	256	0.419	0.369
Jan 2011	Reading	3	86	0.595	0.437
Jan 2011	Reading	4	87	0.665	0.440
Jan 2011	Reading	5	86	0.666	0.433
Jan 2011	Reading	6	210	0.607	0.423
Jan 2011	Reading	7	192	0.679	0.395
Jan 2011	Reading	8	192	0.623	0.404
Jan 2011	Reading	Literature	348	0.568	0.408
Jan 2011	Science	3	91	0.637	0.371
Jan 2011	Science	4	123	0.602	0.348
Jan 2011	Science	5	102	0.482	0.335
Jan 2011	Science	6	178	0.503	0.322
Jan 2011	Science	7	327	0.486	0.322
Jan 2011	Science	8	377	0.504	0.335
Jan 2011	Science	11	115	0.381	0.238
Jan 2011	Science	Biology	390	0.420	0.294
Jan 2011	Science	Chemistry	335	0.355	0.255
Aug 2011	Writing	3	140	0.584	0.392
Aug 2011	Writing	4	149	0.566	0.372
Aug 2011	Writing	5	165	0.566	0.380
Aug 2011	Writing	6	193	0.556	0.369
Aug 2011	Writing	7	176	0.550	0.346

Table 7–1 (continued). Mean *P*-value and Point-Biserial

Meeting Date	Content Area	Grade/Course	Number of Items Field Tested	Mean *P*-value	Mean Point-Biserial
Aug 2011	Writing	8	195	0.538	0.332
Aug 2011	Writing	English Composition	365	0.514	0.357
July 2013	Mathematics	6	156	0.448	0.290
July 2013	Mathematics	7	73	0.431	0.257
July 2013	Mathematics	8	157	0.354	0.204
July 2013	Reading	6	56	0.585	0.351
July 2013	Reading	7	58	0.545	0.339
July 2013	Reading	8	57	0.577	0.358
Jan 2014	Mathematics	K	60	0.798	0.408
Jan 2014	Mathematics	1	90	0.801	0.426
Jan 2014	Mathematics	2	130	0.695	0.437
Jan 2014	Mathematics	3	235	0.596	0.413
Jan 2014	Mathematics	4	248	0.595	0.413
Jan 2014	Mathematics	5	221	0.508	0.326
Jan 2014	Reading	K	84	0.734	0.426
Jan 2014	Reading	1	98	0.575	0.415
Jan 2014	Reading	2	98	0.506	0.441
Jan 2014	Reading	3	178	0.546	0.398
Jan 2014	Reading	4	189	0.577	0.413
Jan 2014	Reading	5	134	0.566	0.364
Jan 2014	Science	K–2 span	280	0.619	0.404
Jan 2014	Science	3	155	0.641	0.391
Jan 2014	Science	4	213	0.570	0.362
Jan 2014	Science	5	152	0.424	0.240
Jan 2014	Writing	K	44	0.823	0.462
Jan 2014	Writing	1	118	0.729	0.444
Jan 2014	Writing	2	117	0.642	0.444
Jan 2014	Writing	3	60	0.626	0.415
Jan 2014	Writing	4	60	0.642	0.398
Jan 2014	Writing	5	71	0.550	0.326
June 2016	Mathematics	6	122	0.473	0.298
June 2016	Mathematics	7	177	0.456	0.286
June 2016	Mathematics	8	151	0.396	0.232
June 2016	Mathematics	Algebra I	150	0.414	0.228
June 2016	Reading	3	22	0.467	0.430
June 2016	Reading	4	22	0.568	0.421
June 2016	Reading	5	22	0.603	0.394

Table 7–1 (continued). Mean *P*-value and Point-Biserial

Meeting Date	Content Area	Grade/Course	Number of Items Field Tested	Mean *P*-value	Mean Point-Biserial
June 2016	Reading	6	126	0.535	0.360
June 2016	Reading	7	126	0.557	0.397
June 2016	Reading	8	126	0.577	0.398
June 2016	Reading	Literature	126	0.532	0.339
June 2016	Science	6	72	0.431	0.233
June 2016	Science	7	159	0.446	0.231
June 2016	Science	8	238	0.447	0.236
June 2016	Science	Biology	136	0.439	0.246
June 2016	Writing	6	93	0.531	0.327
June 2016	Writing	7	93	0.522	0.322
June 2016	Writing	8	110	0.504	0.308
June 2016	Writing	English Composition	104	0.485	0.298
March 2019	Mathematics	K	20	0.778	0.362
March 2019	Mathematics	1	20	0.758	0.389
March 2019	Mathematics	2	20	0.672	0.422
March 2019	Mathematics	3	178	0.602	0.379
March 2019	Mathematics	4	179	0.578	0.362
March 2019	Mathematics	5	180	0.569	0.350
March 2019	Mathematics	6	96	0.495	0.321
March 2019	Mathematics	7	103	0.476	0.328
March 2019	Mathematics	8	99	0.401	0.256
March 2019	Mathematics	Algebra I	299	0.401	0.246
March 2019	Mathematics	Geometry	100	0.378	0.228
March 2019	Mathematics	Algebra II	100	0.375	0.230
March 2019	Reading	K	32	0.527	0.368
March 2019	Reading	1	20	0.500	0.389
March 2019	Reading	2	32	0.459	0.343
March 2019	Reading	3	162	0.448	0.353
March 2019	Reading	4	162	0.484	0.357
March 2019	Reading	5	162	0.483	0.352
March 2019	Reading	6	123	0.508	0.371
March 2019	Reading	7	123	0.476	0.343
March 2019	Reading	8	120	0.503	0.356
March 2019	Reading	Literature	249	0.491	0.340
March 2019	Science	K-2 span	31	0.515	0.321
March 2019	Science	3	89	0.501	0.303
March 2019	Science	4	95	0.474	0.287

Table 7–1 (continued). Mean *P*-value and Point-Biserial

Meeting Date	Content Area	Grade/Course	Number of Items Field Tested	Mean *P*-value	Mean Point-Biserial
March 2019	Science	5	90	0.439	0.273
March 2019	Science	6	97	0.446	0.265
March 2019	Science	7	99	0.479	0.294
March 2019	Science	8	102	0.459	0.269
March 2019	Science	Biology	290	0.421	0.267
March 2019	Science	Chemistry	110	0.356	0.155
March 2019	Writing	K	10	0.713	0.491
March 2019	Writing	1	10	0.520	0.351
March 2019	Writing	2	12	0.445	0.281
March 2019	Writing	3	99	0.525	0.349
March 2019	Writing	4	90	0.589	0.364
March 2019	Writing	5	90	0.549	0.351
March 2019	Writing	6	93	0.517	0.329
March 2019	Writing	7	111	0.518	0.342
March 2019	Writing	8	93	0.514	0.333
March 2019	Writing	English Composition	294	0.475	0.285
May 2020	Science	3	19	0.458	0.336
May 2020	Science	4	22	0.300	0.282
May 2020	Science	5	20	0.293	0.307
May 2020	Science	6	18	0.284	0.275
May 2020	Science	7	19	0.312	0.283
May 2020	Science	8	20	0.283	0.294
May 2020	Science	Biology	40	0.279	0.319

CHAPTER EIGHT: RASCH ITEM CALIBRATION

The particular item response theory (IRT) model used for the Classroom Diagnostic Tools (CDT) is based on the work of Georg Rasch. Rasch models have had a long-standing presence in applied testing programs and have been the methodology used to calibrate the Pennsylvania System of School Assessment (PSSA) items and Keystone Exam items. Consequently, this model was chosen to be used for the CDT. IRT has several advantages over classical test theory, so it has become the standard procedure for analyzing item response data in large-scale assessments. However, IRT models make a number of strong assumptions related to dimensionality, local independence, and model-data fit. Resulting inferences derived from any application of IRT rest strongly on the degree to which the underlying assumptions are met.

This chapter outlines the procedures used for calibrating the CDT items. Generally, item calibration is the process of assigning a difficulty-parameter estimate to each item so that they are placed onto a common scale. This chapter briefly introduces the Rasch model and reports the results from evaluations of the adequacy of the Rasch assumptions. See Chapter Nine for a description of the common scale across grades and courses within a content area and for summaries of the Rasch item statistics for the CDT item pools.

DESCRIPTION OF THE RASCH MODEL

The Rasch partial credit model (RPCM) (Wright & Masters, 1982) was used to calibrate CDT items because the item pools contain multiple item types. The RPCM extends the Rasch model (Rasch, 1960) for dichotomous multiple-choice (0, 1) items so that it accommodates the polytomous evidence-based selected-response and technology-enhanced items. Under the RPCM, for a given item *i* with *mi* score categories, the probability of person *n* scoring *x* (*x* = 0, 1, 2,... *mi*) is given by:

$$P_{ni}\left(X = x\right) = \frac{\exp\sum_{j=0}^{x}(\theta_n - D_{ij})}{\sum_{k=0}^{m_i}\exp\sum_{j=0}^{k}(\theta_n - D_{ij})},\ x = 0,\ 1,\ \ldots,\ m_i$$

where θ_n represents a student's proficiency (ability) level, and D_{ij} is the step difficulty of the j^{th} step on item i. For dichotomous MC items, the RPCM reduces to the standard Rasch model and the single step difficulty is referred to as the item's difficulty. The Rasch model predicts the probability of person n getting item i correct as follows:

$$P_{ni}\left(X = 1\right) = \frac{\exp\left(\theta_n - D_{ij}\right)}{1 + \exp\left(\theta_n - D_{ij}\right)}.$$

The Rasch model places both student ability and item difficulty (estimated in terms of log-odds or logits) on the same continuum. When the model assumptions are met, it also provides person ability estimates that are independent of the items employed in the assessment, and, conversely, estimates item difficulty independently of the sample of examinees.

SOFTWARE AND ESTIMATION ALGORITHM

Item calibration was implemented via the WINSTEPS 3.71 computer program (Linacre, 2009). The unconditional, joint maximum likelihood (UCON) estimation procedure estimates the person parameters (i.e., ability) simultaneously with the item parameters (i.e., difficulty).

CHECKING RASCH ASSUMPTIONS

Because the Rasch model was the basis of all calibration, scoring, and scaling analyses associated with the CDT, the validity of the inferences from these results depends on the degree to which the assumptions of the model are met and how well the model fits the test data. Therefore, it is important to check these assumptions. This section evaluates the dimensionality of the data, local item independence, and model-data fit at the item level. Though a variety of methods are available for assessing these issues, the Rasch analyses and criteria available from WINSTEPS were used here.

UNIDIMENSIONALITY

Rasch models assume that one dominant dimension determines the difference in students' performances. WINSTEPS provides results from a principal components analysis (PCA) that can be used to assess the unidimensionality assumption. Different from standard applications of PCA, WINSTEPS conducts its PCA on the response residuals, not the original observations. That is, the primary dimension from the Rasch model is removed first and then the residual variance is analyzed. The purpose of the analysis is to verify whether any other dominant components exist among the residuals (i.e., they account for a practically significant amount of residual variance). If any other dimensions are found, the unidimensionality assumption would be violated.

WINSTEPS provides three PCA residuals: raw, standardized, and logit. All three should yield similar results. The mixed residual setting was used for the PCA because previous research has demonstrated that raw residuals (PRCOMP=R) give a more realistic estimate of explained variance than do standardized residuals (PRCOMP=S), and standardized residuals are better for decomposing the unexplained variance into contrasts (Linacre, 2009).

Table 8–1 presents the PCA results for the CDT Mathematics item pool. The results include the total variance, variance explained by the model, unexplained total variance, and unexplained variance explained by the first factor (both eigenvalue units and percentage values are shown in the table). In addition, the modeled column provides variance components that would be explained if the data complied with the Rasch definition of unidimensionality.

As can been seen from Table 8–1, the primary dimension in the Rasch model explained between 21 and 63 percent of the total variances across the grades and courses. The empirical and model-based percentages were close, suggesting that the estimation of a primary Rasch dimension was successful. The unexplained variances were between 38 and 79 percent. This includes the Rasch-predicted randomness and any departures in the data from the Rasch model (e.g., departure from unidimensionality).

The most important variance for evaluating dimensionality is in the row named "unexplained variance explained by 1st factor." The eigenvalue of unexplained total variance equals the total number of items, since PCA was conducted with residuals. The eigenvalues of the first factor in the residual (again, this is the second dimension beyond the first Rasch model dimension in WINSTEPS PCA) were between 0.2 and 1.1 percent. Overall, WINSTEPS PCA suggests that there is one clearly dominant dimension for the CDT mathematics item pool.

Table 8–1. Results from PCA of Residuals in WINSTEPS for Mathematics

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
Aug 2010	3	Total variance in observations	208.5	100.0%	100.0%
Aug 2010	3	Variance explained by model	122.5	58.7%	58.5%
Aug 2010	3	Unexplained variance (total)	86	41.3%	41.5%
Aug 2010	3	Unexplained variance explained by 1st factor	1.6	0.8%	
Aug 2010	4	Total variance in observations	167.8	100.0%	100.0%
Aug 2010	4	Variance explained by model	81.8	48.7%	48.1%
Aug 2010	4	Unexplained variance (total)	86	51.3%	51.9%
Aug 2010	4	Unexplained variance explained by 1st factor	1.5	0.9%	
Aug 2010	5	Total variance in observations	177.3	100.0%	100.0%
Aug 2010	5	Variance explained by model	92.3	52.1%	52.9%
Aug 2010	5	Unexplained variance (total)	85	47.9%	47.1%
Aug 2010	5	Unexplained variance explained by 1st factor	1.5	0.9%	
Aug 2010	6	Total variance in observations	606.2	100.0%	100.0%
Aug 2010	6	Variance explained by model	347.2	57.3%	58.0%
Aug 2010	6	Unexplained variance (total)	259	42.7%	42.0%
Aug 2010	6	Unexplained variance explained by 1st factor	2.0	0.3%	
Aug 2010	7	Total variance in observations	529.8	100.0%	100.0%
Aug 2010	7	Variance explained by model	271.8	51.3%	52.3%
Aug 2010	7	Unexplained variance (total)	258	48.7%	47.7%
Aug 2010	7	Unexplained variance explained by 1st factor	2.2	0.4%	
Aug 2010	8	Total variance in observations	476.9	100.0%	100.0%
Aug 2010	8	Variance explained by model	219.9	46.1%	47.3%
Aug 2010	8	Unexplained variance (total)	257	53.9%	52.7%
Aug 2010	8	Unexplained variance explained by 1st factor	2.1	0.4%	
Aug 2010	Algebra I*	Total variance in observations	365.4	100.0%	100.0%
Aug 2010	Algebra I*	Variance explained by model	109.4	29.9%	30.6%
Aug 2010	Algebra I*	Unexplained variance (total)	256	70.1%	69.4%
Aug 2010	Algebra I*	Unexplained variance explained by 1st factor	1.9	0.5%	
Aug 2010	Geometry*	Total variance in observations	408.9	100.0%	100.0%
Aug 2010	Geometry*	Variance explained by model	151.9	37.2%	38.3%
Aug 2010	Geometry*	Unexplained variance (total)	257	62.8%	61.7%
Aug 2010	Geometry*	Unexplained variance explained by 1st factor	1.9	0.5%	

*Grade 11 items were tested on grade 8, Algebra I, Geometry, and Algebra II forms.

Table 8–1 (continued). Results from PCA of Residuals in WINSTEPS for Mathematics

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
Aug 2010	Algebra II*	Total variance in observations	464.8	100.0%	100.0%
Aug 2010	Algebra II*	Variance explained by model	208.8	44.9%	46.1%
Aug 2010	Algebra II*	Unexplained variance (total)	256	55.1%	53.9%
Aug 2010	Algebra II*	Unexplained variance explained by 1st factor	2.0	0.4%	
July 2013	6	Total variance in observations	323.3	100.0%	100.0%
July 2013	6	Variance explained by model	167.3	51.7%	48.4%
July 2013	6	Unexplained variance (total)	156	48.3%	51.6%
July 2013	6	Unexplained variance explained by 1st factor	1.3	0.4%	
July 2013	7	Total variance in observations	148.3	100.0%	100.0%
July 2013	7	Variance explained by model	75.3	50.8%	48.7%
July 2013	7	Unexplained variance (total)	73	49.2%	51.3%
July 2013	7	Unexplained variance explained by 1st factor	1.1	0.8%	
July 2013	8	Total variance in observations	243.3	100.0%	100.0%
July 2013	8	Variance explained by model	86.3	35.5%	33.0%
July 2013	8	Unexplained variance (total)	157	64.5%	67.0%
July 2013	8	Unexplained variance explained by 1st factor	1.3	0.6%	
Jan 2014	K–2**	Total variance in observations	728.0	100.0%	100.0%
Jan 2014	K–2**	Variance explained by model	448.0	61.5%	60.5%
Jan 2014	K–2**	Unexplained variance (total)	280	38.5%	39.5%
Jan 2014	K–2**	Unexplained variance explained by 1st factor	1.8	0.3%	
Jan 2014	3	Total variance in observations	564.0	100.0%	100.0%
Jan 2014	3	Variance explained by model	329.0	58.3%	59.4%
Jan 2014	3	Unexplained variance (total)	235	41.7%	40.6%
Jan 2014	3	Unexplained variance explained by 1st factor	1.9	0.3%	
Jan 2014	4	Total variance in observations	646.9	100.0%	100.0%
Jan 2014	4	Variance explained by model	398.9	61.7%	62.5%
Jan 2014	4	Unexplained variance (total)	248	38.3%	37.5%
Jan 2014	4	Unexplained variance explained by 1st factor	1.9	0.3%	
Jan 2014	5	Total variance in observations	417.9	100.0%	100.0%
Jan 2014	5	Variance explained by model	196.9	47.1%	43.1%
Jan 2014	5	Unexplained variance (total)	221	52.9%	56.9%
Jan 2014	5	Unexplained variance explained by 1st factor	1.2	0.3%	
June 2016	6	Total variance in observations	212.5	100.0%	100.0%
June 2016	6	Variance explained by model	94.5	44.5%	39.8%
June 2016	6	Unexplained variance (total)	118	55.5%	60.2%
June 2016	6	Unexplained variance explained by 1st factor	1.1	0.5%	

*Grade 11 items were tested on grade 8, Algebra I, Geometry, and Algebra II forms.
**Items in kindergarten through grade 2 were co-mingled on forms taken by students in grade 3.

Table 8–1 (continued). Results from PCA of Residuals in WINSTEPS for Mathematics

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
June 2016	7	Total variance in observations	267.9	100.0%	100.0%
June 2016	7	Variance explained by model	101.9	38.0%	32.0%
June 2016	7	Unexplained variance (total)	166	62.0%	68.0%
June 2016	7	Unexplained variance explained by 1st factor	1.1	0.4%	
June 2016	8	Total variance in observations	197.5	100.0%	100.0%
June 2016	8	Variance explained by model	50.5	25.6%	20.9%
June 2016	8	Unexplained variance (total)	147	74.4%	79.1%
June 2016	8	Unexplained variance explained by 1st factor	1.1	0.6%	
June 2016	Algebra I	Total variance in observations	243.8	100.0%	100.0%
June 2016	Algebra I	Variance explained by model	95.8	39.3%	36.8%
June 2016	Algebra I	Unexplained variance (total)	148	60.7%	63.2%
June 2016	Algebra I	Unexplained variance explained by 1st factor	1.1	0.4%	
June 2019	K–2**	Total variance in observations	116.0	100.0%	100.0%
June 2019	K–2**	Variance explained by model	56.0	48.3%	35.6%
June 2019	K–2**	Unexplained variance (total)	60.0	51.7%	64.4%
June 2019	K–2**	Unexplained variance explained by 1st factor	1.2	1.1%	
June 2019	3	Total variance in observations	384.3	100.0%	100.0%
June 2019	3	Variance explained by model	206.3	53.7%	46.7%
June 2019	3	Unexplained variance (total)	178.0	46.3%	53.3%
June 2019	3	Unexplained variance explained by 1st factor	1.2	0.3%	
June 2019	4	Total variance in observations	338.4	100.0%	100.0%
June 2019	4	Variance explained by model	159.4	47.1%	38.0%
June 2019	4	Unexplained variance (total)	179.0	52.9%	62.0%
June 2019	4	Unexplained variance explained by 1st factor	1.1	0.3%	
June 2019	5	Total variance in observations	316.3	100.0%	100.0%
June 2019	5	Variance explained by model	136.3	43.1%	36.5%
June 2019	5	Unexplained variance (total)	180.0	56.9%	63.5%
June 2019	5	Unexplained variance explained by 1st factor	1.1	0.4%	
June 2019	6	Total variance in observations	156.0	100.0%	100.0%
June 2019	6	Variance explained by model	60.0	38.4%	31.1%
June 2019	6	Unexplained variance (total)	96.0	61.6%	68.9%
June 2019	6	Unexplained variance explained by 1st factor	1.1	0.7%	
June 2019	7	Total variance in observations	154.8	100.0%	100.0%
June 2019	7	Variance explained by model	51.8	33.5%	28.4%
June 2019	7	Unexplained variance (total)	103.0	66.5%	71.6%
June 2019	7	Unexplained variance explained by 1st factor	1.1	0.7%	

Table 8–1 (continued). Results from PCA of Residuals in WINSTEPS for Mathematics

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
June 2019	8	Total variance in observations	147.9	100.0%	100.0%
June 2019	8	Variance explained by model	48.9	33.1%	27.6%
June 2019	8	Unexplained variance (total)	99.0	66.9%	72.4%
June 2019	8	Unexplained variance explained by 1st factor	1.1	0.8%	
June 2019	Algebra I	Total variance in observations	456.3	100.0%	100.0%
June 2019	Algebra I	Variance explained by model	157.3	34.5%	33.1%
June 2019	Algebra I	Unexplained variance (total)	299.0	65.5%	66.9%
June 2019	Algebra I	Unexplained variance explained by 1st factor	1.1	0.2%	
June 2019	Geometry	Total variance in observations	158.5	100.0%	100.0%
June 2019	Geometry	Variance explained by model	58.5	36.9%	35.5%
June 2019	Geometry	Unexplained variance (total)	100.0	63.1%	64.5%
June 2019	Geometry	Unexplained variance explained by 1st factor	1.2	0.7%	
June 2019	Algebra II	Total variance in observations	161.0	100.0%	100.0%
June 2019	Algebra II	Variance explained by model	61.0	37.9%	35.9%
June 2019	Algebra II	Unexplained variance (total)	100.0	62.1%	64.1%
June 2019	Algebra II	Unexplained variance explained by 1st factor	1.2	0.7%	

Table 8–2 presents the PCA results for the CDT reading item pool. The primary dimension in the Rasch model explained between 26 and 58 percent of the total variances across the grades and courses. The second dimension (the row named "unexplained variance explained by 1st factor") accounted for between 0.3 and 3.2 percent of the total variance in observations. These results suggest that the CDT reading item pool essentially measures a single dominant dimension.

Table 8–2. Results from PCA of Residuals in WINSTEPS for Reading

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
Jan 2011	3	Total variance in observations	179.8	100.0%	100.0%
Jan 2011	3	Variance explained by model	93.8	52.2%	51.9%
Jan 2011	3	Unexplained variance (total)	86	47.8%	48.1%
Jan 2011	3	Unexplained variance explained by 1st factor	1.7	0.9%	
Jan 2011	4	Total variance in observations	157.4	100.0%	100.0%
Jan 2011	4	Variance explained by model	70.4	44.7%	43.9%
Jan 2011	4	Unexplained variance (total)	87	55.3%	56.1%
Jan 2011	4	Unexplained variance explained by 1st factor	1.6	1.0%	
Jan 2011	5	Total variance in observations	171.5	100.0%	100.0%
Jan 2011	5	Variance explained by model	85.5	49.8%	50.5%
Jan 2011	5	Unexplained variance (total)	86	50.2%	49.5%
Jan 2011	5	Unexplained variance explained by 1st factor	1.7	1.0%	
Jan 2011	6	Total variance in observations	442.8	100.0%	100.0%
Jan 2011	6	Variance explained by model	232.8	52.6%	53.5%
Jan 2011	6	Unexplained variance (total)	210	47.4%	46.5%
Jan 2011	6	Unexplained variance explained by 1st factor	2.3	0.5%	
Jan 2011	7	Total variance in observations	364.4	100.0%	100.0%
Jan 2011	7	Variance explained by model	172.4	47.3%	46.8%
Jan 2011	7	Unexplained variance (total)	192	52.7%	53.2%
Jan 2011	7	Unexplained variance explained by 1st factor	2.1	0.6%	
Jan 2011	8	Total variance in observations	345.5	100.0%	100.0%
Jan 2011	8	Variance explained by model	153.5	44.4%	44.5%
Jan 2011	8	Unexplained variance (total)	192	55.6%	55.5%
Jan 2011	8	Unexplained variance explained by 1st factor	2.0	0.6%	
Jan 2011	Literature	Total variance in observations	699.1	100.0%	100.0%
Jan 2011	Literature	Variance explained by model	351.1	50.2%	50.2%
Jan 2011	Literature	Unexplained variance (total)	348	49.8%	49.8%
Jan 2011	Literature	Unexplained variance explained by 1st factor	2.2	0.3%	
July 2013	6	Total variance in observations	111.7	100.0%	100.0%
July 2013	6	Variance explained by model	55.7	49.8%	47.3%
July 2013	6	Unexplained variance (total)	56	50.2%	52.7%
July 2013	6	Unexplained variance explained by 1st factor	1.5	1.3%	

Table 8–2 (continued). Results from PCA of Residuals in WINSTEPS for Reading

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
July 2013	7	Total variance in observations	103.4	100.0%	100.0%
July 2013	7	Variance explained by model	45.4	43.9%	42.2%
July 2013	7	Unexplained variance (total)	58	56.1%	57.8%
July 2013	7	Unexplained variance explained by 1st factor	1.4	1.4%	
July 2013	8	Total variance in observations	105.4	100.0%	100.0%
July 2013	8	Variance explained by model	48.4	45.9%	44.8%
July 2013	8	Unexplained variance (total)	57	54.1%	55.2%
July 2013	8	Unexplained variance explained by 1st factor	1.4	1.3%	
Jan 2014	K–2*	Total variance in observations	656.5	100.0%	100.0%
Jan 2014	K–2*	Variance explained by model	376.5	57.4%	57.6%
Jan 2014	K–2*	Unexplained variance (total)	280	42.6%	42.4%
Jan 2014	K–2*	Unexplained variance explained by 1st factor	1.9	0.3%	
Jan 2014	3	Total variance in observations	391.5	100.0%	100.0%
Jan 2014	3	Variance explained by model	213.5	54.5%	55.6%
Jan 2014	3	Unexplained variance (total)	178	45.5%	44.4%
Jan 2014	3	Unexplained variance explained by 1st factor	1.9	0.5%	
Jan 2014	4	Total variance in observations	434.7	100.0%	100.0%
Jan 2014	4	Variance explained by model	245.7	56.5%	57.1%
Jan 2014	4	Unexplained variance (total)	189	43.5%	42.9%
Jan 2014	4	Unexplained variance explained by 1st factor	1.7	0.4%	
Jan 2014	4	Total variance in observations	434.7	100.0%	100.0%
Jan 2014	4	Variance explained by model	245.7	56.5%	57.1%
Jan 2014	4	Unexplained variance (total)	189	43.5%	42.9%
Jan 2014	4	Unexplained variance explained by 1st factor	1.7	0.4%	
June 2016	3	Total variance in observations	53.5	100.0%	100.0%
June 2016	3	Variance explained by model	31.5	58.8%	41.7%
June 2016	3	Unexplained variance (total)	22	41.2%	58.3%
June 2016	3	Unexplained variance explained by 1st factor	1.1	2.1%	
June 2016	4	Total variance in observations	54.3	100.0%	100.0%
June 2016	4	Variance explained by model	33.3	61.4%	37.4%
June 2016	4	Unexplained variance (total)	21	38.6%	62.6%
June 2016	4	Unexplained variance explained by 1st factor	1.7	3.2%	
June 2016	5	Total variance in observations	57.5	100.0%	100.0%
June 2016	5	Variance explained by model	36.5	63.5%	43.5%
June 2016	5	Unexplained variance (total)	21	36.5%	56.6%
June 2016	5	Unexplained variance explained by 1st factor	1.2	2.1%	

Table 8–2 (continued). Results from PCA of Residuals in WINSTEPS for Reading

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
June 2016	6	Total variance in observations	232.3	100.0%	100.0%
June 2016	6	Variance explained by model	110.3	47.5%	45.1%
June 2016	6	Unexplained variance (total)	122	52.5%	54.9%
June 2016	6	Unexplained variance explained by 1st factor	1.6	0.7%	
June 2016	7	Total variance in observations	245.8	100.0%	100.0%
June 2016	7	Variance explained by model	120.8	49.1%	47.2%
June 2016	7	Unexplained variance (total)	125	50.9%	52.8%
June 2016	7	Unexplained variance explained by 1st factor	1.6	0.6%	
June 2016	8	Variance explained by model	132.5	51.9%	49.8%
June 2016	8	Unexplained variance (total)	123	48.1%	50.2%
June 2016	8	Unexplained variance explained by 1st factor	1.7	0.7%	
June 2016	Literature	Total variance in observations	206.4	100.0%	100.0%
June 2016	Literature	Variance explained by model	82.4	39.9%	39.0%
June 2016	Literature	Unexplained variance (total)	124	60.1%	61.0%
June 2016	Literature	Unexplained variance explained by 1st factor	1.5	0.7%	
June 2019	K–2*	Total variance in observations	117.8	100.0%	100.0%
June 2019	K–2*	Variance explained by model	33.8	28.7%	26.0%
June 2019	K–2*	Unexplained variance (total)	84.0	71.3%	74.0%
June 2019	K–2*	Unexplained variance explained by 1st factor	1.5	1.3%	
June 2019	3	Total variance in observations	272.3	100.0%	100.0%
June 2019	3	Variance explained by model	110.3	40.5%	39.3%
June 2019	3	Unexplained variance (total)	162.0	59.5%	60.7%
June 2019	3	Unexplained variance explained by 1st factor	1.6	0.6%	
June 2019	4	Total variance in observations	288.0	100.0%	100.0%
June 2019	4	Variance explained by model	126.0	43.8%	42.7%
June 2019	4	Unexplained variance (total)	162.0	56.2%	57.3%
June 2019	4	Unexplained variance explained by 1st factor	1.7	0.6%	
June 2019	5	Total variance in observations	291.2	100.0%	100.0%
June 2019	5	Variance explained by model	129.2	44.4%	42.7%
June 2019	5	Unexplained variance (total)	162.0	55.6%	57.3%
June 2019	5	Unexplained variance explained by 1st factor	1.6	0.6%	
June 2019	6	Total variance in observations	216.3	100.0%	100.0%
June 2019	6	Variance explained by model	93.3	43.1%	42.2%
June 2019	6	Unexplained variance (total)	123.0	56.9%	57.8%
June 2019	6	Unexplained variance explained by 1st factor	1.6	0.7%	

Table 8–2 (continued). Results from PCA of Residuals in WINSTEPS for Reading

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
June 2019	7	Variance explained by model	89.2	42.0%	41.2%
June 2019	7	Unexplained variance (total)	123.0	58.0%	58.8%
June 2019	7	Unexplained variance explained by 1st factor	1.6	0.8%	
June 2019	8	Total variance in observations	209.3	100.0%	100.0%
June 2019	8	Variance explained by model	89.3	42.7%	41.5%
June 2019	8	Unexplained variance (total)	120.0	57.3%	58.5%
June 2019	8	Unexplained variance explained by 1st factor	1.7	0.8%	
June 2019	Literature	Total variance in observations	396.2	100.0%	100.0%
June 2019	Literature	Variance explained by model	147.2	37.2%	36.4%
June 2019	Literature	Unexplained variance (total)	249.0	62.8%	63.6%
June 2019	Literature	Unexplained variance explained by 1st factor	1.5	0.4%	

*Items in kindergarten through grade 2 were co-mingled on forms taken by students in grade 3.

Table 8–3 presents the PCA results for the CDT science item pool. The primary dimension in the Rasch model explained between 20 and 68 percent of the total variances across the grades and courses. The second dimension (the row named "unexplained variance explained by 1st factor") accounted for between 0.3 and 4.6 percent of the total variance in observations. These results suggest that the CDT science item pool essentially measures a single dominant dimension.

Table 8–3. Results from PCA of Residuals in WINSTEPS for Science

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
Jan 2011	3	Total variance in observations	229.1	100.0%	100.0%
Jan 2011	3	Variance explained by model	138.1	60.3%	60.3%
Jan 2011	3	Unexplained variance (total)	91	39.7%	39.7%
Jan 2011	3	Unexplained variance explained by 1st factor	1.7	0.7%	
Jan 2011	4	Total variance in observations	285.9	100.0%	100.0%
Jan 2011	4	Variance explained by model	162.9	57.0%	56.9%
Jan 2011	4	Unexplained variance (total)	123	43.0%	43.1%
Jan 2011	4	Unexplained variance explained by 1st factor	1.5	0.5%	
Jan 2011	5	Total variance in observations	161.9	100.0%	100.0%
Jan 2011	5	Variance explained by model	59.9	37.0%	37.4%
Jan 2011	5	Unexplained variance (total)	102	63.0%	62.6%
Jan 2011	5	Unexplained variance explained by 1st factor	1.5	0.9%	
Jan 2011	6	Total variance in observations	290.8	100.0%	100.0%
Jan 2011	6	Variance explained by model	112.8	38.8%	39.3%
Jan 2011	6	Unexplained variance (total)	178	61.2%	60.7%
Jan 2011	6	Unexplained variance explained by 1st factor	2.1	0.7%	
Jan 2011	7	Total variance in observations	487.1	100.0%	100.0%
Jan 2011	7	Variance explained by model	160.1	32.9%	33.3%
Jan 2011	7	Unexplained variance (total)	327	67.1%	66.7%
Jan 2011	7	Unexplained variance explained by 1st factor	2.2	0.4%	
Jan 2011	8*	Total variance in observations	658.8	100.0%	100.0%
Jan 2011	8*	Variance explained by model	281.8	42.8%	43.9%
Jan 2011	8*	Unexplained variance (total)	377	57.2%	56.1%
Jan 2011	8*	Unexplained variance explained by 1st factor	1.9	0.3%	
Jan 2011	Biology	Total variance in observations	545.2	100.0%	100.0%
Jan 2011	Biology	Variance explained by model	155.2	28.5%	29.7%
Jan 2011	Biology	Unexplained variance (total)	390	71.5%	70.3%
Jan 2011	Biology	Unexplained variance explained by 1st factor	2.0	0.4%	
Jan 2011	Chemistry	Total variance in observations	418.1	100.0%	100.0%
Jan 2011	Chemistry	Variance explained by model	83.1	19.9%	20.1%
Jan 2011	Chemistry	Unexplained variance (total)	335	80.1%	79.9%
Jan 2011	Chemistry	Unexplained variance explained by 1st factor	2.0	0.5%	
Jan 2014	K–2	Total variance in observations	652.2	100.0%	100.0%
Jan 2014	K–2	Variance explained by model	372.2	57.1%	57.4%

Table 8–3 (continued). Results from PCA of Residuals in WINSTEPS for Science

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
Jan 2014	K–2	Unexplained variance (total)	280	42.9%	42.6%
Jan 2014	K–2	Unexplained variance explained by 1st factor	2.6	0.4%	
Jan 2014	3	Total variance in observations	369.9	100.0%	100.0%
Jan 2014	3	Variance explained by model	214.9	58.1%	57.8%
Jan 2014	3	Unexplained variance (total)	155	41.9%	42.2%
Jan 2014	3	Unexplained variance explained by 1st factor	2.0	0.5%	
Jan 2014	4	Total variance in observations	668.3	100.0%	100.0%
Jan 2014	4	Variance explained by model	455.3	68.1%	68.0%
Jan 2014	4	Unexplained variance (total)	213	31.9%	32.0%
Jan 2014	4	Unexplained variance explained by 1st factor	2.0	0.3%	
Jan 2014	5	Total variance in observations	235.5	100.0%	100.0%
Jan 2014	5	Variance explained by model	83.5	35.5%	34.5%
Jan 2014	5	Unexplained variance (total)	152	64.5%	65.5%
Jan 2014	5	Unexplained variance explained by 1st factor	1.3	0.6%	
June 2016	6	Total variance in observations	99.6	100.0%	100.0%
June 2016	6	Variance explained by model	33.6	33.7%	29.2%
June 2016	6	Unexplained variance (total)	66	66.3%	70.8%
June 2016	6	Unexplained variance explained by 1st factor	1.1	1.1%	
June 2016	7	Total variance in observations	218.9	100.0%	100.0%
June 2016	7	Variance explained by model	65.9	30.1%	24.9%
June 2016	7	Unexplained variance (total)	153	69.9%	75.1%
June 2016	7	Unexplained variance explained by 1st factor	1.1	0.5%	
June 2016	8	Total variance in observations	338.2	100.0%	100.0%
June 2016	8	Variance explained by model	112.2	33.2%	28.2%
June 2016	8	Unexplained variance (total)	226	66.8%	71.8%
June 2016	8	Unexplained variance explained by 1st factor	1.2	0.3%	
June 2016	Biology	Total variance in observations	205.4	100.0%	100.0%
June 2016	Biology	Variance explained by model	70.4	34.3%	32.0%
June 2016	Biology	Unexplained variance (total)	135	65.7%	68.0%
June 2016	Biology	Unexplained variance explained by 1st factor	1.1	0.5%	
June 2019	K–2**	Total variance in observations	49.6	100.0%	100.0%
June 2019	K–2**	Variance explained by model	18.6	37.5%	26.9%
June 2019	K–2**	Unexplained variance (total)	31.0	62.5%	73.1%
June 2019	K–2**	Unexplained variance explained by 1st factor	1.4	2.8%	
June 2019	3	Total variance in observations	154.7	100.0%	100.0%
June 2019	3	Variance explained by model	65.7	42.5%	36.0%
June 2019	3	Unexplained variance (total)	89.0	57.5%	64.0%
June 2019	3	Unexplained variance explained by 1st factor	1.1	0.7%	

Table 8–3 (continued). Results from PCA of Residuals in WINSTEPS for Science

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
June 2019	4	Total variance in observations	140.1	100.0%	100.0%
June 2019	4	Variance explained by model	45.1	32.2%	27.3%
June 2019	4	Unexplained variance (total)	95.0	67.8%	72.7%
June 2019	4	Unexplained variance explained by 1st factor	1.1	0.8%	
June 2019	5	Total variance in observations	128.0	100.0%	100.0%
June 2019	5	Variance explained by model	38.0	29.7%	24.8%
June 2019	5	Unexplained variance (total)	90.0	70.3%	75.2%
June 2019	5	Unexplained variance explained by 1st factor	1.1	0.9%	
June 2019	6	Total variance in observations	136.2	100.0%	100.0%
June 2019	6	Variance explained by model	39.2	28.8%	24.2%
June 2019	6	Unexplained variance (total)	97.0	71.2%	75.8%
June 2019	6	Unexplained variance explained by 1st factor	1.1	0.8%	
June 2019	7	Total variance in observations	135.5	100.0%	100.0%
June 2019	7	Variance explained by model	36.5	26.9%	22.3%
June 2019	7	Unexplained variance (total)	99.0	73.1%	77.7%
June 2019	7	Unexplained variance explained by 1st factor	1.1	0.8%	
June 2019	8	Total variance in observations	152.6	100.0%	100.0%
June 2019	8	Variance explained by model	50.6	33.1%	27.6%
June 2019	8	Unexplained variance (total)	102.0	66.9%	72.4%
June 2019	8	Unexplained variance explained by 1st factor	1.1	0.7%	
June 2019	Biology	Total variance in observations	414.2	100.0%	100.0%
June 2019	Biology	Variance explained by model	124.2	30.0%	28.7%
June 2019	Biology	Unexplained variance (total)	290.0	70.0%	71.3%
June 2019	Biology	Unexplained variance explained by 1st factor	1.1	0.3%	
June 2019	Chemistry	Total variance in observations	142.9	100.0%	100.0%
June 2019	Chemistry	Variance explained by model	42.9	30.0%	27.5%
June 2019	Chemistry	Unexplained variance (total)	100.0	70.0%	72.5%
June 2019	Chemistry	Unexplained variance explained by 1st factor	1.3	0.9%	
May 2020	3	Total variance in observations	50.3	100.0%	100.0%
May 2020	3	Variance explained by model	31.3	62.2%	37.5%
May 2020	3	Unexplained variance (total)	19.0	37.8%	62.5%
May 2020	3	Unexplained variance explained by 1st factor	1.2	2.5%	
May 2020	4	Total variance in observations	50.1	100.0%	100.0%
May 2020	4	Variance explained by model	28.1	56.1%	34.2%
May 2020	4	Unexplained variance (total)	22.0	43.9%	65.8%
May 2020	4	Unexplained variance explained by 1st factor	1.3	2.5%	
May 2020	5	Total variance in observations	83.4	100.0%	100.0%
May 2020	5	Variance explained by model	63.4	76.0%	60.8%

Table 8–3 (continued). Results from PCA of Residuals in WINSTEPS for Science

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
May 2020	5	Unexplained variance (total)	20.0	24.0%	39.2%
May 2020	5	Unexplained variance explained by 1st factor	1.4	1.7%	
May 2020	6	Total variance in observations	27.8	100.0%	100.0%
May 2020	6	Variance explained by model	9.8	35.1%	19.8%
May 2020	6	Unexplained variance (total)	18.0	64.9%	80.2%
May 2020	6	Unexplained variance explained by 1st factor	1.3	4.6%	
May 2020	7	Total variance in observations	44.6	100.0%	100.0%
May 2020	7	Variance explained by model	25.6	57.4%	34.3%
May 2020	7	Unexplained variance (total)	19.0	42.6%	65.7%
May 2020	7	Unexplained variance explained by 1st factor	1.3	2.8%	
May 2020	8	Total variance in observations	39.3	100.0%	100.0%
May 2020	8	Variance explained by model	19.3	49.1%	29.4%
May 2020	8	Unexplained variance (total)	20.0	50.9%	70.6%
May 2020	8	Unexplained variance explained by 1st factor	1.3	3.2%	
May 2020	Biology	Total variance in observations	72.7	100.0%	100.0%
May 2020	Biology	Variance explained by model	32.7	45.0%	28.5%
May 2020	Biology	Unexplained variance (total)	40.0	55.0%	71.5%
May 2020	Biology	Unexplained variance explained by 1st factor	1.1	1.5%	

*Grade 11 items were tested on grade 8 forms.

Table 8–4 presents the PCA results for the CDT writing item pool. The primary dimension in the Rasch model explained between 22 and 55 percent of the total variances across the grades and courses. The second dimension (the row named "unexplained variance explained by 1st factor") accounted for between 0.3 and 2.2 percent of the total variance in observations. These results suggest that the CDT writing item pool essentially measures a single dominant dimension.

Table 8–4. Results from PCA of Residuals in WINSTEPS for Writing

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
Aug 2011	3	Total variance in observations	297.7	100.0%	100.0%
Aug 2011	3	Variance explained by model	157.7	53.0%	55.0%
Aug 2011	3	Unexplained variance (total)	140	47.0%	45.0%
Aug 2011	3	Unexplained variance explained by 1st factor	1.7	0.6%	
Aug 2011	4	Total variance in observations	283.6	100.0%	100.0%
Aug 2011	4	Variance explained by model	134.6	47.5%	49.0%
Aug 2011	4	Unexplained variance (total)	149	52.5%	51.0%
Aug 2011	4	Unexplained variance explained by 1st factor	1.8	0.6%	
Aug 2011	5	Total variance in observations	280.7	100.0%	100.0%
Aug 2011	5	Variance explained by model	115.7	41.2%	42.2%
Aug 2011	5	Unexplained variance (total)	165	58.8%	57.8%
Aug 2011	5	Unexplained variance explained by 1st factor	1.8	0.6%	
Aug 2011	6	Total variance in observations	340.5	100.0%	100.0%
Aug 2011	6	Variance explained by model	147.5	43.3%	44.2%
Aug 2011	6	Unexplained variance (total)	193	56.7%	55.8%
Aug 2011	6	Unexplained variance explained by 1st factor	2.0	0.6%	
Aug 2011	7	Total variance in observations	317.9	100.0%	100.0%
Aug 2011	7	Variance explained by model	141.9	44.6%	45.5%
Aug 2011	7	Unexplained variance (total)	176	55.4%	54.5%
Aug 2011	7	Unexplained variance explained by 1st factor	2.1	0.6%	
Aug 2011	8	Total variance in observations	336.0	100.0%	100.0%
Aug 2011	8	Variance explained by model	141.0	42.0%	42.4%
Aug 2011	8	Unexplained variance (total)	195	58.0%	57.6%
Aug 2011	8	Unexplained variance explained by 1st factor	2.3	0.7%	
Aug 2011	English Composition	Total variance in observations	763.2	100.0%	100.0%
Aug 2011	English Composition	Variance explained by model	398.2	52.2%	53.4%
Aug 2011	English Composition	Unexplained variance (total)	365	47.8%	46.6%
Aug 2011	English Composition	Unexplained variance explained by 1st factor	2.3	0.3%	
Jan 2014	K–2*	Total variance in observations	93.2	100.0%	100.0%
Jan 2014	K–2*	Variance explained by model	49.2	52.8%	39.9%
Jan 2014	K–2*	Unexplained variance (total)	44	47.2%	60.1%
Jan 2014	K–2*	Unexplained variance explained by 1st factor	2.0	2.2%	
Jan 2014	3	Total variance in observations	132.5	100.0%	100.0%
Jan 2014	3	Variance explained by model	72.5	54.7%	54.6%

Table 8–4 (continued). Results from PCA of Residuals in WINSTEPS for Writing

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
Jan 2014	3	Unexplained variance (total)	60	45.3%	45.4%
Jan 2014	3	Unexplained variance explained by 1st factor	1.8	1.4%	
Jan 2014	4	Total variance in observations	132.4	100.0%	100.0%
Jan 2014	4	Variance explained by model	72.4	54.7%	55.4%
Jan 2014	4	Unexplained variance (total)	60	45.3%	44.6%
Jan 2014	4	Unexplained variance explained by 1st factor	1.7	1.3%	
Jan 2014	5	Total variance in observations	146.5	100.0%	100.0%
Jan 2014	5	Variance explained by model	75.5	51.5%	47.7%
Jan 2014	5	Unexplained variance (total)	71	48.5%	52.3%
Jan 2014	5	Unexplained variance explained by 1st factor	1.3	0.9%	
June 2016	6	Total variance in observations	154.7	100.0%	100.0%
June 2016	6	Variance explained by model	64.7	41.8%	38.2%
June 2016	6	Unexplained variance (total)	90	58.2%	61.8%
June 2016	6	Unexplained variance explained by 1st factor	1.2	0.8%	
June 2016	7	Total variance in observations	126.6	100.0%	100.0%
June 2016	7	Variance explained by model	34.6	27.3%	22.4%
June 2016	7	Unexplained variance (total)	92	72.7%	77.6%
June 2016	7	Unexplained variance explained by 1st factor	1.2	0.9%	
June 2016	8	Total variance in observations	150.7	100.0%	100.0%
June 2016	8	Variance explained by model	44.7	29.7%	25.2%
June 2016	8	Unexplained variance (total)	106	70.3%	74.8%
June 2016	8	Unexplained variance explained by 1st factor	1.2	0.8%	
June 2016	English Composition	Total variance in observations	149.5	100.0%	100.0%
June 2016	English Composition	Variance explained by model	47.5	31.8%	26.3%
June 2016	English Composition	Unexplained variance (total)	102	68.2%	73.7%
June 2016	English Composition	Unexplained variance explained by 1st factor	1.3	0.9%	
June 2019	K–2*	Total variance in observations	69.0	100.0%	100.0%
June 2019	K–2*	Variance explained by model	37.0	53.6%	40.9%
June 2019	K–2*	Unexplained variance (total)	32.0	46.4%	59.1%
June 2019	K–2*	Unexplained variance explained by 1st factor	1.5	2.2%	
June 2019	3	Total variance in observations	165.5	100.0%	100.0%
June 2019	3	Variance explained by model	66.5	40.2%	36.4%
June 2019	3	Unexplained variance (total)	99.0	59.8%	63.6%
June 2019	3	Unexplained variance explained by 1st factor	1.3	0.8%	
June 2019	4	Total variance in observations	163.6	100.0%	100.0%
June 2019	4	Variance explained by model	73.6	45.0%	37.8%
June 2019	4	Unexplained variance (total)	90.0	55.0%	62.2%
June 2019	4	Unexplained variance explained by 1st factor	1.3	0.8%	

Table 8–4 (continued). Results from PCA of Residuals in WINSTEPS for Writing

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
June 2019	5	Total variance in observations	139.1	100.0%	100.0%
June 2019	5	Variance explained by model	49.1	35.3%	29.9%
June 2019	5	Unexplained variance (total)	90.0	64.7%	70.1%
June 2019	5	Unexplained variance explained by 1st factor	1.2	0.9%	
June 2019	6	Total variance in observations	136.5	100.0%	100.0%
June 2019	6	Variance explained by model	43.5	31.9%	26.3%
June 2019	6	Unexplained variance (total)	93.0	68.1%	73.7%
June 2019	6	Unexplained variance explained by 1st factor	1.2	0.9%	
June 2019	7	Total variance in observations	158.9	100.0%	100.0%
June 2019	7	Variance explained by model	47.9	30.1%	25.7%
June 2019	7	Unexplained variance (total)	111.0	69.9%	74.3%
June 2019	7	Unexplained variance explained by 1st factor	1.2	0.7%	
June 2019	8	Total variance in observations	131.9	100.0%	100.0%
June 2019	8	Variance explained by model	38.9	29.5%	24.5%
June 2019	8	Unexplained variance (total)	93.0	70.5%	75.5%
June 2019	8	Unexplained variance explained by 1st factor	1.3	1.0%	
June 2019	English Composition	Total variance in observations	523.2	100.0%	100.0%
June 2019	English Composition	Variance explained by model	229.2	43.8%	41.3%
June 2019	English Composition	Unexplained variance (total)	294.0	56.2%	58.7%
June 2019	English Composition	Unexplained variance explained by 1st factor	1.5	0.3%	

*Items in kindergarten through grade 2 were co-mingled on forms taken by students in grade 3.

LOCAL INDEPENDENCE

Local independence (LI) is a fundamental assumption of IRT. No relationship should exist between examinees' responses to different items after accounting for the abilities measured by a test. In formal statistical terms, a test X that is comprised of items X_1, X_2,…X_n is locally independent with respect to the latent variable θ if, for all x = (x_1, x_2,…x_n) and θ,

$$P(\mathbf{X}=\mathbf{x}\mid\theta)=\prod_{i=1}^{I}P(X_i=x_i\mid\theta).$$

This formula essentially states that the probability of any pattern of responses across all items (*x*), after conditioning on the abilities measured by the test, should be equal to the product of the conditional probabilities across each item (cf. the multiplication rule for independent events where the joint probabilities are equal to the product of the associated marginal probabilities).

The equation above shows the condition after satisfying the "strong form" of local independence. A "weak form" of local independence (WLI) was proposed by McDonald (1979). The distinction is important, as many indicators of local dependency are actually framed by WLI. The requirement here would be for the conditional covariances of all pairs of item responses, conditioned on the abilities, to be equal to zero. When this assumption is met, the joint probability of responses to an item pair, conditioned on abilities, is the product of the probabilities of responses to these two items, as show below. (This is a "weaker" form because higher-order dependencies among items are allowed.) Based on the WLI, the following expression can be derived:

$$P(X_i=x_i,X_j=x_j\mid\theta)=P(X_i=x_i\mid\theta)P(X_j=x_j\mid\theta).$$

Marais and Andrich (2008) pointed out that local item dependence in the Rasch model can occur in two ways that some may not distinguish. The first way occurs when the assumption of unidimensionality is violated. Here, other nuisance dimensions besides a dominant dimension also determine students' performance (this can be called "trait dependence"). The second violation occurs when responses to an item depend on responses to another. This is a violation of statistical independence and can be called "response dependence." Many people treat the assumptions of "unidimensionality" and "local independence" as one phenomenon and believe that once unidimensionality holds, that local independence also holds. By distinguishing the two sources of local dependence, one can see that while local independence can be related to unidimensionality, the two are different assumptions, and, therefore, require different tests.

Residual item correlations provided in WINSTEPS for each item pair were used to assess the local dependence among the CDT items. In general, these residuals are computed as follows. First, expected item performance based on the Rasch model is determined using ability and item parameter estimates. Next, deviation (residual) between the examinees' expected and observed performance is determined for each item. Finally, for each item pair, a correlation between the respective deviations is computed.

As previously mentioned, three types of residual correlations are available in WINSTEPS: raw, standardized, and logit. Since the three residual correlations are very similar, the default "standardized residual correlation" in WINSTEPS was used for these analyses. Tables 8–5 through 8–8 show the summary statistics—mean, standard deviation (SD), minimum (Min), maximum (Max), and several percentiles (P10, P25, P50, P75, P90)—for all the residual correlations for each content area and grade/course. The total number of item pairs (N) and the number of pairs with the residual correlations greater than 0.20 are also reported in the tables.

Table 8–5. Summary of Item Residual Correlations for Mathematics

Date	Grade/ Course	N	Mean	SD	Min	P_{10}	P_{25}	P_{50}	P_{75}	P_{90}	Max	< -.20	>.20
Aug 2010	3	1,372	-0.03	0.03	-0.15	-0.06	-0.04	-0.03	-0.01	0.01	0.32	0	2
Aug 2010	4	1,122	-0.03	0.04	-0.18	-0.08	-0.06	-0.03	-0.01	0.01	0.28	0	2
Aug 2010	5	1,132	-0.03	0.04	-0.17	-0.07	-0.05	-0.03	-0.01	0.01	0.38	0	1
Aug 2010	6	5,410	-0.02	0.04	-0.15	-0.06	-0.04	-0.02	0.00	0.02	0.34	0	12
Aug 2010	7	5,409	-0.02	0.04	-0.24	-0.07	-0.05	-0.02	0.00	0.03	0.35	3	4
Aug 2010	8	4,935	-0.02	0.06	-0.36	-0.10	-0.06	-0.02	0.01	0.05	0.27	18	3
Aug 2010	Algebra I	5,024	-0.02	0.04	-0.19	-0.07	-0.05	-0.02	0.00	0.02	0.26	0	2
Aug 2010	Geometry	5,470	-0.02	0.04	-0.20	-0.07	-0.04	-0.02	0.00	0.02	0.27	0	1
Aug 2010	Algebra II	5,457	-0.02	0.04	-0.18	-0.07	-0.05	-0.02	0.00	0.02	0.22	0	2
July 2013	6	12,090	-0.01	0.01	-0.12	-0.02	-0.01	0.00	0.00	0.00	0.06	0	0
July 2013	7	2,628	-0.01	0.01	-0.05	-0.03	-0.02	-0.01	-0.01	0.00	0.01	0	0
July 2013	8	12,246	-0.01	0.01	-0.09	-0.02	-0.01	0.00	0.00	0.01	0.06	0	0
Jan 2014	K–2	2,660	-0.04	0.06	-0.23	-0.11	-0.08	-0.05	-0.01	0.02	0.35	4	4
Jan 2014	3	2,278	-0.05	0.06	-0.24	-0.12	-0.09	-0.05	-0.01	0.02	0.27	12	2
Jan 2014	4	2,462	-0.05	0.05	-0.24	-0.11	-0.08	-0.05	-0.01	0.02	0.46	2	2
Jan 2014	5	24,310	0.00	0.01	-0.05	-0.01	-0.01	0.00	0.00	0.00	0.02	0	0
June 2016	6	6,903	-0.01	0.00	-0.03	-0.01	-0.01	-0.01	-0.01	0.00	0.01	0	0
June 2016	7	13,695	-0.01	0.00	-0.03	-0.01	-0.01	-0.01	0.00	0.00	0.01	0	0
June 2016	8	10,731	-0.01	0.01	-0.03	-0.01	-0.01	-0.01	0.00	0.00	0.01	0	0
June 2016	Algebra I	10,878	-0.01	0.00	-0.02	-0.01	-0.01	-0.01	0.00	0.00	0.01	0	0
June 2019	K–2*	1,770	-0.02	0.01	-0.09	-0.03	-0.02	-0.02	-0.01	0.00	0.02	0	0
June 2019	3	15,753	-0.01	0.00	-0.05	-0.01	-0.01	-0.01	0.00	0.00	0.02	0	0
June 2019	4	15,931	-0.01	0.00	-0.04	-0.01	-0.01	-0.01	0.00	0.00	0.01	0	0
June 2019	5	16,110	-0.01	0.00	-0.03	-0.01	-0.01	-0.01	0.00	0.00	0.01	0	0
June 2019	6	4,560	-0.01	0.00	-0.03	-0.02	-0.01	-0.01	-0.01	0.00	0.00	0	0
June 2019	7	5,253	-0.01	0.00	-0.03	-0.01	-0.01	-0.01	-0.01	0.00	0.01	0	0
June 2019	8	4,851	-0.01	0.01	-0.04	-0.02	-0.01	-0.01	-0.01	0.00	0.01	0	0
June 2019	Algebra I	44,551	0.00	0.00	-0.02	-0.01	-0.01	0.00	0.00	0.00	0.01	0	0
June 2019	Geometry	4,950	-0.01	0.01	-0.05	-0.02	-0.02	-0.01	0.00	0.00	0.02	0	0
June 2019	Algebra II	4,950	-0.01	0.01	-0.07	-0.02	-0.02	-0.01	0.00	0.00	0.02	0	0

Table 8–6. Summary of Item Residual Correlations for Reading

Date	Grade/ Course	N	Mean	SD	Min	P_{10}	P_{25}	P_{50}	P_{75}	P_{90}	Max	< -.20	>.20
Jan 2011	3	1,334	-0.02	0.04	-0.17	-0.07	-0.04	-0.02	-0.01	0.01	0.14	0	0
Jan 2011	4	1,272	-0.02	0.03	-0.18	-0.07	-0.04	-0.02	-0.01	0.01	0.27	0	2
Jan 2011	5	1,262	-0.02	0.03	-0.17	-0.06	-0.04	-0.02	-0.01	0.01	0.18	0	0
Jan 2011	6	4,245	-0.02	0.05	-0.24	-0.07	-0.04	-0.02	0.00	0.02	0.35	2	13
Jan 2011	7	3,782	-0.02	0.04	-0.23	-0.07	-0.04	-0.02	0.00	0.02	0.22	2	1
Jan 2011	8	3,782	-0.02	0.04	-0.26	-0.07	-0.04	-0.02	0.00	0.03	0.34	2	5
Jan 2011	Literature	7,517	-0.02	0.05	-0.28	-0.09	-0.04	-0.01	0.01	0.04	0.40	25	10
July 2013	6	1,540	-0.02	0.05	-0.43	-0.03	-0.01	0.00	0.00	0.00	0.05	42	0
July 2013	7	1,653	-0.02	0.05	-0.33	-0.04	-0.01	0.00	0.00	0.00	0.01	38	0
July 2013	8	1,596	-0.02	0.05	-0.32	-0.04	-0.01	0.00	0.00	0.00	0.02	39	0
Jan 2014	K–2	2,660	-0.05	0.06	-0.26	-0.12	-0.09	-0.05	-0.01	0.02	0.29	7	5
Jan 2014	3	1,709	-0.05	0.05	-0.23	-0.11	-0.08	-0.05	-0.02	0.02	0.20	2	0
Jan 2014	4	1,888	-0.05	0.05	-0.23	-0.10	-0.08	-0.05	-0.02	0.01	0.20	1	0
Jan 2014	5	8,911	-0.01	0.02	-0.26	-0.01	-0.01	0.00	0.00	0.00	0.03	33	0
June 2016	3	231	-0.04	0.02	-0.10	-0.08	-0.06	-0.04	-0.02	-0.01	0.00	0	0
June 2016	4	210	-0.04	0.06	-0.74	-0.08	-0.06	-0.03	-0.02	0.00	0.01	1	0
June 2016	5	210	-0.04	0.03	-0.13	-0.09	-0.06	-0.04	-0.02	-0.01	0.00	0	0
June 2016	6	7,381	-0.01	0.04	-0.36	0.00	0.00	0.00	0.00	0.00	0.00	117	0
June 2016	7	7,750	-0.01	0.04	-0.40	0.00	0.00	0.00	0.00	0.00	0.09	123	0
June 2016	8	7,503	-0.01	0.04	-0.38	0.00	0.00	0.00	0.00	0.00	0.04	115	0
June 2016	Literature	7,626	-0.01	0.04	-0.33	0.00	0.00	0.00	0.00	0.00	0.00	161	0
June 2019	K–2*	3,486	-0.01	0.06	-0.45	0.00	0.00	0.00	0.00	0.00	0.00	121	0
June 2019	3	13,041	-0.01	0.04	-0.38	0.00	0.00	0.00	0.00	0.00	0.05	150	0
June 2019	4	13,041	-0.01	0.04	-0.40	0.00	0.00	0.00	0.00	0.00	0.06	152	0
June 2019	5	13,041	-0.01	0.04	-0.38	0.00	0.00	0.00	0.00	0.00	0.06	156	0
June 2019	6	7,503	-0.01	0.04	-0.46	0.00	0.00	0.00	0.00	0.00	0.06	121	0
June 2019	7	7,503	-0.01	0.04	-0.44	0.00	0.00	0.00	0.00	0.00	0.09	109	0
June 2019	8	7,140	-0.01	0.04	-0.48	0.00	0.00	0.00	0.00	0.00	0.00	118	0
June 2019	Literature	30,876	0.00	0.03	-0.33	0.00	0.00	0.00	0.00	0.00	0.02	319	0

Table 8–7. Summary of Item Residual Correlations for Science

Date	Grade/ Course	N	Mean	SD	Min	P_{10}	P_{25}	P_{50}	P_{75}	P_{90}	Max	< -.20	>.20
Jan 2011	3	1,400	-0.03	0.03	-0.16	-0.07	-0.04	-0.02	-0.01	0.01	0.09	0	0
Jan 2011	4	1,950	-0.02	0.03	-0.19	-0.07	-0.04	-0.02	0.00	0.01	0.09	0	0
Jan 2011	5	1,530	-0.03	0.03	-0.17	-0.07	-0.04	-0.02	-0.01	0.01	0.08	0	0
Jan 2011	6	3,642	-0.02	0.04	-0.18	-0.07	-0.04	-0.02	0.00	0.02	0.19	0	0
Jan 2011	7	6,934	-0.02	0.04	-0.22	-0.08	-0.04	-0.01	0.00	0.03	0.24	7	2
Jan 2011	8	6,881	-0.02	0.05	-0.27	-0.09	-0.04	-0.01	0.00	0.02	0.24	30	2
Jan 2011	Biology	8,255	-0.02	0.05	-0.24	-0.09	-0.04	-0.01	0.00	0.03	0.26	17	1
Jan 2011	Chemistry	7,105	-0.02	0.05	-0.22	-0.08	-0.04	-0.01	0.01	0.03	0.24	8	2
Jan 2014	K–2	2,660	-0.05	0.10	-0.43	-0.17	-0.11	-0.05	0.01	0.08	0.68	152	28
Jan 2014	3	1,510	-0.05	0.06	-0.33	-0.12	-0.09	-0.05	-0.01	0.03	0.25	5	3
Jan 2014	4	2,069	-0.05	0.09	-0.31	-0.16	-0.11	-0.05	0.01	0.07	0.32	83	13
Jan 2014	5	11,476	-0.01	0.01	-0.08	-0.02	-0.01	-0.01	0.00	0.01	0.06	0	0
June 2016	6	2,145	-0.02	0.01	-0.05	-0.03	-0.02	-0.02	-0.01	0.00	0.02	0	0
June 2016	7	11,628	-0.01	0.01	-0.04	-0.01	-0.01	-0.01	0.00	0.00	0.01	0	0
June 2016	8	25,425	0.00	0.01	-0.03	-0.01	-0.01	0.00	0.00	0.00	0.02	0	0
June 2016	Biology	9,045	-0.01	0.00	-0.02	-0.01	-0.01	-0.01	-0.01	0.00	0.00	0	0
June 2019	K–2*	465	-0.03	0.03	-0.15	-0.07	-0.05	-0.03	-0.01	0.00	0.04	0	0
June 2019	3	3,916	-0.01	0.01	-0.05	-0.02	-0.02	-0.01	-0.01	0.00	0.01	0	0
June 2019	4	4,465	-0.01	0.01	-0.04	-0.02	-0.02	-0.01	0.00	0.00	0.02	0	0
June 2019	5	4,005	-0.01	0.01	-0.06	-0.02	-0.02	-0.01	-0.01	0.00	0.01	0	0
June 2019	6	4,656	-0.01	0.01	-0.04	-0.02	-0.01	-0.01	-0.01	0.00	0.01	0	0
June 2019	7	4,851	-0.01	0.00	-0.03	-0.02	-0.01	-0.01	-0.01	0.00	0.00	0	0
June 2019	8	5,151	-0.01	0.01	-0.03	-0.02	-0.01	-0.01	-0.01	0.00	0.01	0	0
June 2019	Biology	41,905	0.00	0.00	-0.02	-0.01	-0.01	0.00	0.00	0.00	0.01	0	0
June 2019	Chemistry	4,950	-0.01	0.01	-0.06	-0.03	-0.02	-0.01	0.00	0.00	0.04	0	0
May 2020	3	171	-0.05	0.02	-0.14	-0.08	-0.07	-0.05	-0.04	-0.02	0.00	0	0
May 2020	4	231	-0.05	0.03	-0.14	-0.08	-0.06	-0.04	-0.02	-0.01	0.00	0	0
May 2020	5	190	-0.05	0.04	-0.24	-0.10	-0.07	-0.04	-0.02	-0.01	0.01	1	0
May 2020	6	153	-0.06	0.05	-0.26	-0.12	-0.07	-0.04	-0.03	-0.02	-0.01	5	0
May 2020	7	171	-0.05	0.03	-0.22	-0.09	-0.06	-0.05	-0.04	-0.03	0.00	1	0
May 2020	8	190	-0.05	0.03	-0.19	-0.09	-0.06	-0.04	-0.03	-0.02	0.00	0	0
May 2020	Biology	780	-0.02	0.01	-0.08	-0.04	-0.03	-0.02	-0.01	-0.01	0.00	0	0

Table 8–8. Summary of Item Residual Correlations for Writing

Date	Grade/ Course	N	Mean	SD	Min	P_{10}	P_{25}	P_{50}	P_{75}	P_{90}	Max	< -.20	>.20
Aug 2011	3	2,205	-0.02	0.05	-0.26	-0.08	-0.04	-0.02	0.00	0.02	0.19	6	0
Aug 2011	4	2,315	-0.02	0.05	-0.24	-0.09	-0.04	-0.02	0.00	0.02	0.28	9	2
Aug 2011	5	2,580	-0.02	0.05	-0.25	-0.09	-0.04	-0.02	0.00	0.02	0.19	11	0
Aug 2011	6	3,795	-0.02	0.05	-0.25	-0.08	-0.04	-0.02	0.01	0.03	0.27	4	5
Aug 2011	7	3,544	-0.02	0.05	-0.24	-0.08	-0.04	-0.02	0.00	0.03	0.24	10	2
Aug 2011	8	3,815	-0.02	0.07	-0.29	-0.11	-0.05	-0.02	0.01	0.06	0.29	58	13
Aug 2011	Eng. Comp	7,705	-0.02	0.06	-0.30	-0.10	-0.04	-0.01	0.01	0.05	0.33	72	18
Jan 2014	K–2	2,641	-0.05	0.09	-0.39	-0.15	-0.11	-0.05	0.01	0.06	0.35	84	19
Jan 2014	3	570	-0.05	0.06	-0.20	-0.12	-0.08	-0.05	-0.02	0.02	0.23	1	1
Jan 2014	4	570	-0.05	0.04	-0.18	-0.10	-0.08	-0.05	-0.02	0.01	0.21	0	1
Jan 2014	5	2,485	-0.01	0.02	-0.13	-0.04	-0.02	-0.01	0.00	0.01	0.05	0	0
June 2016	6	4,005	-0.01	0.01	-0.05	-0.02	-0.02	-0.01	-0.01	0.00	0.02	0	0
June 2016	7	4,186	-0.01	0.01	-0.06	-0.02	-0.02	-0.01	0.00	0.00	0.01	0	0
June 2016	8	5,565	-0.01	0.01	-0.05	-0.02	-0.01	-0.01	0.00	0.00	0.01	0	0
June 2016	Eng. Comp	5,151	-0.01	0.01	-0.13	-0.03	-0.02	-0.01	0.00	0.00	0.03	0	0
June 2019	K–2*	496	-0.03	0.04	-0.39	-0.07	-0.05	-0.02	-0.01	0.00	0.04	3	0
June 2019	3	4,851	-0.01	0.01	-0.21	-0.03	-0.02	-0.01	0.00	0.00	0.05	1	0
June 2019	4	4,005	-0.01	0.01	-0.12	-0.03	-0.02	-0.01	0.00	0.00	0.04	0	0
June 2019	5	4,005	-0.01	0.01	-0.09	-0.03	-0.02	-0.01	0.00	0.00	0.06	0	0
June 2019	6	4,278	-0.01	0.01	-0.07	-0.02	-0.02	-0.01	0.00	0.00	0.02	0	0
June 2019	7	6,105	-0.01	0.01	-0.05	-0.02	-0.01	-0.01	0.00	0.00	0.02	0	0
June 2019	8	4,278	-0.01	0.01	-0.14	-0.03	-0.02	-0.01	0.00	0.00	0.04	0	0
June 2019	Eng. Comp	43,071	0.00	0.01	-0.24	-0.02	-0.01	0.00	0.00	0.01	0.18	2	0

Across the content areas and grades/courses, the mean residual correlations were slightly negative and the values were close to zero. The vast majority of the correlations were very small, suggesting local item independence generally holds for the CDT mathematics, reading, science, and writing item pools.

ITEM FIT

WINSTEPS provides two item-fit statistics (infit and outfit) for evaluating the degree to which the Rasch model predicts the observed item responses. Each fit statistic can be expressed as a mean square (MnSq) statistic or on a standardized metric (Zstd with mean = 0 and variance = 1). MnSq values are more oriented toward practical significance, while Zstd values are more oriented toward statistical significance. MnSq values are presented in this chapter.

Both infit and outfit MnSq are the average of standardized residual variance (the difference between the observed score and the Rasch estimated score divided by the square root of the Rasch model variance). The difference is that the outfit statistic gives all examinees equal weight in computing the fit and tends to be affected more by unexpected responses far from the person, item, or rating scale category measure (i.e., it is more sensitive to outlying, off-target, low information responses). The infit statistic is weighted by the examinee locations relative to item difficulty and tends to be affected more by unexpected responses close to the person, item, or rating scale category measure (i.e., informative, on-target responses). Some feel that extreme infit values are a greater threat to the measurement process than extreme outfit values since most tests intend to measure the on-target population rather than extreme outliers.

The expected MnSq value is 1.0, and it can range from 0 to infinity. Deviation in excess of the expected value can be interpreted as noise or lack of fit between the items and the model. Values lower than the expected value can be interpreted as item redundancy or overfitting items (too predictable, too much redundancy), and values greater than the expected value indicate underfitting items (too unpredictable, too much noise). Rules of thumb regarding practically significant MnSq values vary. More conservative users might prefer items with MnSq values that range from 0.8 to 1.2. Others believe reasonable test results can be achieved with values from 0.5 to 1.5. In the following results, values outside of 0.7 to 1.3 are given practical importance.

Table 8–9 presents the summary statistics of infit and outfit mean square statistics for the CDT item pools, including the mean, standard deviation, minimum, and maximum values. The number of items within the range of (0.7, 1.3) is also reported in Table 8–9. As can been seen, the mean values for both fit statistics were close to 1.00 for nearly all grades/courses. Nearly all items had infit values falling in the range of (0.7, 1.3). These results indicate that the Rasch model fits the CDT data well.

Table 8–9. Summary of Infit and Outfit Mean Square Statistics

Date	Content Area	Grade/Course	Number of Items	Infit Mean	Infit SD	Infit Min	Infit Max	Infit [0.7,1.3]	Outfit Mean	Outfit SD	Outfit Min	Outfit Max	Outfit [0.7,1.3]
Aug 2010	Mathematics	3	86	0.99	0.08	0.78	1.17	86/86	0.99	0.24	0.21	1.56	71/86
Aug 2010	Mathematics	4	86	0.99	0.08	0.81	1.20	86/86	0.98	0.18	0.50	1.65	78/86
Aug 2010	Mathematics	5	85	0.99	0.12	0.80	1.32	84/85	1.00	0.24	0.46	1.56	69/85
Aug 2010	Mathematics	6	259	0.99	0.11	0.80	1.38	256/259	1.00	0.31	0.40	3.92	217/259
Aug 2010	Mathematics	7	258	1.00	0.12	0.80	1.49	253/258	1.01	0.25	0.56	2.24	213/258
Aug 2010	Mathematics	8	257	1.00	0.11	0.75	1.37	254/257	1.03	0.22	0.48	2.40	226/257
Aug 2010	Mathematics	11	149	0.99	0.10	0.80	1.27	149/149	0.99	0.18	0.67	1.67	141/149
Aug 2010	Mathematics	Algebra I	256	1.00	0.09	0.79	1.28	256/256	1.02	0.14	0.65	1.61	249/256
Aug 2010	Mathematics	Geometry	257	1.00	0.10	0.81	1.31	256/257	1.02	0.17	0.66	1.78	239/257
Aug 2010	Mathematics	Algebra II	256	1.00	0.10	0.78	1.41	254/256	1.03	0.20	0.66	1.99	233/256
Jan 2011	Reading	3	86	0.99	0.12	0.74	1.30	86/86	0.97	0.24	0.40	1.53	66/86
Jan 2011	Reading	4	87	0.99	0.10	0.79	1.28	87/87	0.95	0.22	0.32	1.58	74/87
Jan 2011	Reading	5	86	0.96	0.09	0.78	1.22	86/86	0.91	0.20	0.44	1.64	72/86
Jan 2011	Reading	6	210	1.01	0.13	0.70	1.30	210/210	1.02	0.31	0.37	2.65	151/210
Jan 2011	Reading	7	192	1.00	0.10	0.76	1.30	192/192	0.96	0.23	0.21	2.00	162/192
Jan 2011	Reading	8	192	0.98	0.11	0.75	1.33	191/192	0.96	0.22	0.41	1.84	158/192
Jan 2011	Reading	Literature	348	1.01	0.13	0.75	1.31	347/348	1.01	0.25	0.38	2.00	282/348
Jan 2011	Science	3	91	1.01	0.09	0.83	1.20	91/91	1.00	0.21	0.45	1.48	80/91
Jan 2011	Science	4	123	1.01	0.08	0.85	1.23	123/123	1.00	0.18	0.52	1.81	112/123
Jan 2011	Science	5	102	1.00	0.08	0.84	1.21	102/102	1.02	0.16	0.74	1.85	98/102
Jan 2011	Science	6	178	1.00	0.09	0.80	1.22	178/178	1.02	0.17	0.61	1.82	165/178
Jan 2011	Science	7	327	0.99	0.09	0.78	1.22	327/327	1.01	0.17	0.54	1.83	300/327
Jan 2011	Science	8	377	1.02	0.12	0.77	1.37	372/377	1.06	0.24	0.57	2.12	307/377
Jan 2011	Science	11	115	1.08	0.10	0.81	1.30	115/115	1.19	0.26	0.73	2.19	82/115
Jan 2011	Science	Biology	390	1.00	0.08	0.84	1.28	390/390	1.03	0.14	0.73	1.63	372/390
Jan 2011	Science	Chemistry	335	1.00	0.06	0.85	1.26	335/335	1.02	0.09	0.79	1.48	333/335
Aug 2011	Writing	3	140	0.99	0.11	0.80	1.43	139/140	1.00	0.24	0.42	1.95	115/140
Aug 2011	Writing	4	149	0.99	0.10	0.79	1.26	149/149	1.00	0.24	0.52	1.74	123/149
Aug 2011	Writing	5	165	0.98	0.09	0.80	1.24	165/165	0.97	0.19	0.62	1.92	151/165
Aug 2011	Writing	6	193	0.99	0.10	0.78	1.23	193/193	0.98	0.20	0.53	1.76	170/193
Aug 2011	Writing	7	176	1.00	0.11	0.75	1.36	175/176	1.02	0.23	0.56	1.92	147/176
Aug 2011	Writing	8	195	0.99	0.11	0.77	1.31	194/195	0.99	0.21	0.45	1.68	166/195
Aug 2011	Writing	Eng. Comp.	365	1.00	0.12	0.77	1.38	362/365	1.03	0.25	0.38	2.16	304/365
July 2013	Mathematics	6	156	1.07	0.14	0.78	1.50	144/156	1.35	0.62	0.51	4.77	96/156
July 2013	Mathematics	7	73	1.11	0.13	0.82	1.40	69/73	1.52	0.68	0.76	4.74	33/73
July 2013	Mathematics	8	157	1.14	0.13	0.87	1.45	138/157	1.61	0.58	0.85	3.46	62/157
July 2013	Reading	6	56	1.03	0.13	0.78	1.31	55/56	1.13	0.37	0.58	2.48	35/56

Table 8–9 (continued). Summary of Infit and Outfit Mean Square Statistics

Date	Content Area	Grade/Course	Number of Items	Infit Mean	Infit SD	Infit Min	Infit Max	Infit [0.7,1.3]	Outfit Mean	Outfit SD	Outfit Min	Outfit Max	Outfit [0.7,1.3]
July 2013	Reading	7	58	1.05	0.14	0.82	1.42	55/58	1.17	0.38	0.65	2.91	41/58
July 2013	Reading	8	57	1.03	0.13	0.78	1.32	56/57	1.11	0.29	0.48	2.03	42/57
Jan 2014	Mathematics	K	60	0.98	0.12	0.77	1.34	58/60	0.90	0.30	0.40	1.53	37/60
Jan 2014	Mathematics	1	91	0.97	0.12	0.76	1.33	89/91	0.92	0.30	0.23	2.00	61/91
Jan 2014	Mathematics	2	130	0.99	0.10	0.77	1.29	130/130	0.98	0.27	0.36	1.95	99/130
Jan 2014	Mathematics	3	235	0.99	0.12	0.77	1.44	231/235	1.02	0.31	0.47	3.11	191/235
Jan 2014	Mathematics	4	248	1.00	0.12	0.75	1.31	247/248	1.03	0.27	0.45	2.21	199/248
Jan 2014	Mathematics	5	221	1.02	0.11	0.79	1.37	218/221	1.07	0.25	0.58	2.22	182/221
Jan 2014	Reading	K	84	0.97	0.11	0.77	1.36	83/84	0.91	0.24	0.39	1.51	61/84
Jan 2014	Reading	1	98	0.99	0.12	0.77	1.35	96/98	1.02	0.35	0.36	2.75	73/98
Jan 2014	Reading	2	98	0.98	0.11	0.76	1.24	98/98	1.02	0.25	0.44	1.80	77/98
Jan 2014	Reading	3	178	1.00	0.12	0.77	1.29	178/178	1.04	0.31	0.43	2.44	127/178
Jan 2014	Reading	4	189	1.00	0.11	0.78	1.35	188/189	1.01	0.28	0.40	2.70	149/189
Jan 2014	Reading	5	134	1.01	0.11	0.77	1.28	134/134	1.04	0.24	0.44	1.91	112/134
Jan 2014	Science	K-2 grade span	280	0.99	0.13	0.73	1.43	273/280	1.01	0.34	0.23	2.79	199/280
Jan 2014	Science	3	155	0.99	0.11	0.72	1.29	155/155	0.98	0.28	0.23	1.99	114/155
Jan 2014	Science	4	213	1.00	0.11	0.70	1.27	213/213	1.01	0.24	0.37	1.88	179/213
Jan 2014	Science	5	152	1.07	0.15	0.70	1.59	141/152	1.16	0.29	0.50	2.39	111/152
Jan 2014	Writing	K	44	0.90	0.11	0.73	1.20	44/44	0.72	0.26	0.33	1.38	20/44
Jan 2014	Writing	1	118	0.96	0.15	0.70	1.42	117/118	0.89	0.32	0.27	1.76	74/118
Jan 2014	Writing	2	117	0.98	0.13	0.70	1.46	115/117	0.99	0.26	0.32	1.65	93/117
Jan 2014	Writing	3	60	0.98	0.12	0.78	1.22	60/60	0.98	0.27	0.35	1.97	48/60
Jan 2014	Writing	4	60	1.00	0.11	0.83	1.34	59/60	1.02	0.29	0.60	2.41	51/60
Jan 2014	Writing	5	71	1.03	0.13	0.71	1.37	70/71	1.13	0.40	0.61	2.59	48/71
June 2016	Mathematics	6	122	1.08	0.13	0.87	1.49	113/122	1.31	0.36	0.72	2.38	70/122
June 2016	Mathematics	7	176	1.09	0.13	0.84	1.54	161/176	1.42	0.48	0.74	3.42	89/176
June 2016	Mathematics	8	150	1.13	0.12	0.85	1.61	139/150	1.61	0.50	0.82	3.32	51/150
June 2016	Mathematics	Algebra I	149	1.10	0.09	0.85	1.36	148/149	1.49	0.47	0.73	3.45	57/149
June 2016	Reading	3	22	1.13	0.17	0.85	1.49	18/22	1.15	0.19	0.82	1.54	16/22
June 2016	Reading	4	22	1.10	0.15	0.87	1.44	19/22	1.15	0.30	0.76	2.24	19/22
June 2016	Reading	5	21	1.10	0.13	0.96	1.40	20/21	1.14	0.20	0.91	1.67	18/21
June 2016	Reading	6	123	1.06	0.13	0.81	1.54	121/123	1.13	0.29	0.58	2.48	98/123
June 2016	Reading	7	126	1.04	0.15	0.79	1.51	122/126	1.12	0.37	0.40	2.91	90/126
June 2016	Reading	8	124	1.06	0.16	0.79	2.00	115/124	1.16	0.40	0.50	3.14	82/124
June 2016	Reading	Literature	125	1.07	0.12	0.75	1.36	122/125	1.24	0.38	0.60	2.53	83/125
June 2016	Science	6	72	1.08	0.10	0.87	1.30	72/72	1.27	0.35	0.73	2.36	45/72
June 2016	Science	7	159	1.08	0.09	0.82	1.34	158/159	1.29	0.32	0.64	2.28	98/159

Table 8–9 (continued). Summary of Infit and Outfit Mean Square Statistics

Date	Content Area	Grade/Course	Number of Items	Infit Mean	Infit SD	Infit Min	Infit Max	Infit [0.7,1.3]	Outfit Mean	Outfit SD	Outfit Min	Outfit Max	Outfit [0.7,1.3]
June 2016	Science	8	238	1.07	0.10	0.77	1.34	236/238	1.27	0.36	0.50	3.55	151/238
June 2016	Science	Biology	136	1.08	0.10	0.87	1.51	135/136	1.25	0.24	0.83	1.94	88/136
June 2016	Writing	6	93	1.06	0.12	0.83	1.34	91/93	1.24	0.47	0.70	4.66	62/93
June 2016	Writing	7	93	1.08	0.10	0.81	1.39	91/93	1.31	0.45	0.70	3.14	59/93
June 2016	Writing	8	110	1.09	0.11	0.88	1.37	106/110	1.37	0.48	0.76	3.93	63/110
June 2016	Writing	Eng. Comp.	104	1.08	0.11	0.75	1.34	103/104	1.46	0.84	0.58	8.30	51/104
June 2019	Mathematics	K	20	1.00	0.14	0.84	1.38	19/20	0.97	0.27	0.63	1.57	14/20
June 2019	Mathematics	1	20	1.00	0.11	0.84	1.25	20/20	0.98	0.27	0.53	1.47	15/20
June 2019	Mathematics	2	20	0.97	0.10	0.79	1.14	20/20	1.00	0.40	0.59	2.50	18/20
June 2019	Mathematics	3	178	1.02	0.11	0.81	1.38	174/178	1.13	0.41	0.40	3.97	142/178
June 2019	Mathematics	4	179	1.03	0.10	0.80	1.27	179/179	1.12	0.28	0.53	2.17	139/179
June 2019	Mathematics	5	180	1.05	0.10	0.85	1.32	179/180	1.14	0.27	0.66	2.12	136/180
June 2019	Mathematics	6	96	1.09	0.11	0.88	1.45	93/96	1.28	0.32	0.71	2.22	60/96
June 2019	Mathematics	7	103	1.09	0.12	0.86	1.45	101/103	1.35	0.45	0.73	3.07	60/103
June 2019	Mathematics	8	99	1.14	0.12	0.89	1.40	93/99	1.62	0.56	0.86	4.00	32/99
June 2019	Mathematics	Algebra I	299	1.14	0.11	0.86	1.45	270/299	1.58	0.56	0.73	5.27	110/299
June 2019	Mathematics	Geometry	100	1.18	0.15	0.88	1.51	82/100	1.84	0.75	0.80	5.11	25/100
June 2019	Mathematics	Algebra II	100	1.13	0.15	0.86	1.58	86/100	1.61	0.60	0.86	3.80	37/100
June 2019	Reading	K	32	1.01	0.15	0.82	1.37	30/32	1.03	0.22	0.71	1.60	28/32
June 2019	Reading	1	20	1.00	0.10	0.87	1.22	20/20	1.00	0.14	0.76	1.27	20/20
June 2019	Reading	2	32	1.05	0.15	0.82	1.43	30/32	1.08	0.24	0.72	1.55	25/32
June 2019	Reading	3	162	1.10	0.16	0.81	1.68	145/162	1.16	0.27	0.59	2.51	125/162
June 2019	Reading	4	162	1.09	0.17	0.75	1.67	139/162	1.19	0.35	0.52	2.78	109/162
June 2019	Reading	5	162	1.07	0.16	0.77	1.64	147/162	1.16	0.33	0.61	2.35	116/162
June 2019	Reading	6	123	1.06	0.16	0.76	1.60	114/123	1.14	0.35	0.61	2.93	87/123
June 2019	Reading	7	123	1.09	0.16	0.76	1.62	112/123	1.20	0.34	0.54	2.59	85/123
June 2019	Reading	8	120	1.09	0.15	0.79	1.67	111/120	1.19	0.32	0.63	2.34	81/120
June 2019	Reading	Literature	249	1.07	0.14	0.74	1.53	238/249	1.20	0.39	0.59	3.41	171/249
June 2019	Science	K-2 grade span	31	1.11	0.16	0.82	1.37	27/31	1.37	0.58	0.72	3.23	16/31
June 2019	Science	3	89	1.09	0.12	0.78	1.38	87/89	1.37	0.45	0.67	3.20	45/89
June 2019	Science	4	95	1.11	0.11	0.79	1.39	92/95	1.39	0.47	0.60	3.58	44/95
June 2019	Science	5	90	1.09	0.11	0.81	1.30	90/90	1.27	0.31	0.62	2.34	51/90
June 2019	Science	6	97	1.10	0.12	0.84	1.34	95/97	1.28	0.36	0.68	2.53	60/97
June 2019	Science	7	99	1.08	0.10	0.86	1.29	99/99	1.21	0.27	0.72	2.37	73/99
June 2019	Science	8	102	1.08	0.10	0.86	1.31	101/102	1.27	0.36	0.75	2.60	64/102
June 2019	Science	Biology	290	1.11	0.12	0.81	1.45	276/290	1.31	0.33	0.67	2.94	166/290
June 2019	Science	Chemistry	100	1.06	0.08	0.87	1.25	100/100	1.16	0.16	0.78	1.83	84/100

Table 8–9 (continued). Summary of Infit and Outfit Mean Square Statistics

Date	Content Area	Grade/Course	Number of Items	Infit Mean	Infit SD	Infit Min	Infit Max	Infit [0.7,1.3]	Outfit Mean	Outfit SD	Outfit Min	Outfit Max	Outfit [0.7,1.3]
June 2019	Writing	K	10	0.96	0.12	0.73	1.10	10/10	0.81	0.20	0.37	1.14	8/10
June 2019	Writing	1	10	1.07	0.19	0.71	1.25	10/10	1.47	0.82	0.51	2.90	5/10
June 2019	Writing	2	12	1.13	0.17	0.90	1.36	9/12	2.15	2.02	0.85	6.91	7/12
June 2019	Writing	3	99	1.10	0.14	0.78	1.44	91/99	1.39	0.82	0.39	8.12	54/99
June 2019	Writing	4	90	1.09	0.13	0.81	1.45	85/90	1.31	0.60	0.55	4.05	54/90
June 2019	Writing	5	90	1.09	0.14	0.79	1.47	83/90	1.24	0.42	0.49	2.80	54/90
June 2019	Writing	6	93	1.12	0.13	0.78	1.41	87/93	1.30	0.39	0.47	2.80	48/93
June 2019	Writing	7	111	1.11	0.13	0.76	1.42	101/111	1.32	0.41	0.63	2.77	70/111
June 2019	Writing	8	93	1.14	0.14	0.79	1.48	82/93	1.41	0.58	0.57	3.84	47/93
June 2019	Writing	Eng. Comp.	294	1.16	0.21	0.66	1.72	219/294	1.61	1.00	0.22	9.69	124/294
May 2020	Science	3	19	1.04	0.09	0.87	1.16	19/19	1.27	0.42	0.81	2.26	13/19
May 2020	Science	4	22	1.05	0.15	0.88	1.54	21/22	1.28	0.48	0.78	2.98	14/22
May 2020	Science	5	20	1.00	0.08	0.86	1.19	20/20	1.01	0.30	0.40	1.84	15/20
May 2020	Science	6	18	1.06	0.10	0.92	1.27	18/18	1.17	0.21	0.88	1.66	13/18
May 2020	Science	7	19	1.05	0.12	0.81	1.25	19/19	1.15	0.25	0.74	1.76	15/19
May 2020	Science	8	20	1.02	0.10	0.85	1.20	20/20	1.16	0.32	0.79	2.02	13/20
May 2020	Science	Biology	40	1.04	0.12	0.87	1.48	39/40	1.16	0.27	0.76	1.79	30/40

RASCH ITEM STATISTICS

As noted earlier, the Rasch model expresses item difficulty (and student ability) in units referred to as *logits*, rather than on the percent-correct metric. In the simplest case, a logit is a transformed *p*-value with the average *p*-value becoming a logit of zero. In this form, logits resemble *z*-scores or standard normal deviates; a very difficult item might have a logit of +4.0 and a very easy item might have a logit of –4.0. However, they have no formal relationship to the normal distribution.

The logit metric has several mathematical advantages over *p*-values. Logits have an interval scale, meaning that two items with logits of 0.0 and +1.0, respectively, are the same distance apart as two items with logits of +3.0 and +4.0. Logits are not dependent on the ability level of the students. For example, a test form can have a mean logit of zero, whether the average item *p*-value for the student sample is 0.8 or 0.3.

The standard Rasch calibration procedure arbitrarily sets the mean difficulty of the items in any calibration at zero. For each CDT stand-alone field-test event and content area, all grades and courses were calibrated separately with the exception of grade 11 items in Mathematics and Science. As a result, items in each grade or course were centered at zero. See Chapter Nine for a description of how item parameters within a content area were re-scaled across grades and courses to build a single (vertical) scale.

For each CDT embedded field-test event and content area, field-test items were calibrated anchoring on operational items’ parameters. As a result, the embedded field-test items were placed on operational vertical scale.

Rasch item difficulty measure on the vertical scale and associated standard error for all items field tested prior to 2018-2019 can be found in Appendix B of the 20178-2018 technical report. Statistics for items field tested in 2018–2019 or later can be found in Appendix B of the corresponding year’s technical report.

CHAPTER NINE: VERTICAL LINKING

The Classroom Diagnostic Tools (CDT) is designed to enable educators to identify students' academic strengths and areas of need. As such, it is necessary for some students to take items out of grade or course level. In order to do this, all items within a content area must be on a common (vertical) scale.

As previously mentioned in Chapter Eight, items from the first stand-alone field-test event for each CDT content area and grade or course were calibrated separately and centered at zero. This chapter outlines the procedures used for vertically linking CDT items across grades and courses within a content area. The end results are four separate vertical scales—one for each content area.

Also mentioned in Chapter Eight, for each content area, the items from all embedded field-test events and the second stand-alone field-test event were calibrated anchoring on operational items' parameters. As a result, all field-test items after the first stand-alone field-test events were placed on the operational vertical scale.

VERTICAL LINKING DESIGN

The first CDT stand-alone field tests were designed to build vertical scales across all grades and courses within a content area. In order to accomplish this, some field-test forms had items from one grade above or below in addition to on-grade or course-level items.

Stand-alone field tests in each content area had two types of forms:

1. Vertical linking form
2. On-grade-only form

Students who received vertical linking forms took a set of on-grade items and a set of items either one grade above or one grade below. Students who received on-grade-only forms took just on-grade items.

All items in the pool were field tested on one or more forms. In Mathematics, on-grade items were chained across adjacent forms to provide a horizontal link across forms within a grade. There were eight to ten horizontal links across adjacent forms. In all other content areas, 10 on-grade items appeared on each form within a grade or course. These common items provide a horizontal link across forms within a grade.[1]

Items used in vertical linking were administered to students one grade above or one grade below in order to link the forms across grades. DRC test development specialists selected items to be administered off-grade level with the following guidelines:

- There are two types of linking sets.
  - Items administered one grade below (e.g., grade 7 items administered to grade 6 students).
  - Items administered one grade above (e.g., grade 7 items administered to grade 8 students).
- Linking sets span the diagnostic categories.
- Linking sets span the estimated difficulty range (item developers estimate easy, medium, or hard).
- Students have a reasonable chance of correctly answering a linking item based on the instruction received.
  - For items administered in the grade above, students should have received instruction the previous year.
  - For items administered in the grade below, they should be extensions of concepts the students have already covered, not something completely new.

[1] The change in horizontal linking design after the Mathematics field test was in response to lower-than-expected participation. Using the same horizontal links on all forms within a grade results in higher *n*-counts.

In Mathematics, each set of linking items appeared on two forms, once located at the beginning and once located at the end to counterbalance possible position effect. In all other content areas, vertical linking items were co-mingled throughout the form with on-grade items.[2]

See Tables 6–1 through 6–4 in Chapter Six for details on the stand-alone field tests including number of items, number of forms, and number of vertical linking forms.

VERTICAL LINKING — MATHEMATICS

Links were made between adjacent grades, grade 8 to Algebra I, Algebra I to Algebra II, and grade 8 to Geometry. Table 9–1 below shows the number of linking items from the lower grade and the upper grade for each link. There were two sets of linking items for each link and direction. For example, in linking grade 5 to grade 6, there were 30 grade 5 items (lower grade) and 20 grade 6 items (upper grade). The 30 grade 5 items were in two sets of 15, while the 20 grade 6 items were in two sets of 10. The number of linking items differs across grades because forms in grades 3, 4, and 5 had 25 items total while all of the others had 35. There was no overlap of linking items among the sets.

Table 9–1. Mathematics Linking Item Detail

Link	Lower Grade	Upper Grade	Total
Grade 3 to Grade 4	20	20	40
Grade 4 to Grade 5	20	20	40
Grade 5 to Grade 6	30	20	50
Grade 6 to Grade 7	30	30	60
Grade 8 to Grade 7	30	30	60
Algebra I to Grade 8	30	30	60
Algebra II to Algebra I	30	30	60
Geometry to Grade 8	30	30	60

A visual representation of the vertical linking design is provided in Table 9–2. Rows are item level and columns are forms. For example, looking at the second row, you can see grade 4 items were on grades 3, 4, and 5 forms. Grade 4 items on grade 4 forms were on-grade items. Grade 4 items on grade 3 and grade 5 forms were vertical linking items. These items also appeared on grade 4 forms and were used to calculate the vertical linking shift parameter.

In linking grades 4 and 5, look at the four cells in Table 9–2 where grade 4 and grade 5 rows and columns cross. There were 86 grade 4 items, and of those 86 items, 20 items were also given to grade 5 as linking items. Similarly, there were 85 grade 5 items, and 20 out of the 85 items were given to grade 4 students as linking items.

Items used to link to a lower grade were different from items used to link to an upper grade. For example, the 30 grade 7 items administered on grade 6 forms were not the same as the 30 grade 7 items administered on grade 8 forms.

[2] The change in vertical linking design after the Mathematics field test was in response to lower-than-expected participation.

Table 9–2. Mathematics Vertical Linking Design of Forms

Gr. 3 Forms	Gr. 4 Forms	Gr. 5 Forms	Gr. 6 Forms	Gr. 7 Forms	Gr. 8 Forms	Alg I Forms	Geo Forms	Alg II Forms
Gr. 3 Items (86)	Gr. 3 Items (20)							
Gr. 4 Items (20)	Gr. 4 Items (86)	Gr. 4 Items (20)						
	Gr. 5 Items (20)	Gr. 5 Items (85)	Gr. 5 Items (30)					
		Gr. 6 Items (20)	Gr. 6 Items (259)	Gr. 6 Items (30)				
			Gr. 7 Items (30)	Gr. 7 Items (258)	Gr. 7 Items (30)			
				Gr. 8 Items (30)	Gr. 8 Items (257)	Gr. 8 Items (30)	Gr. 8 Items (30)	
					Gr. 11 Items (30)	Gr. 11 Items (50)	Gr. 11 Items (50)	Gr. 11 Items (50)
					Alg I Items (15)	Alg I Items (256)		Alg I Items (30)
					Geo Items (15)		Geo Items (257)	
						Alg II Items (30)		Alg II Items (256)

See Appendix C for details related to vertical linking items such as *n*-counts, Eligible Content, and diagnostic categories.

VERTICAL LINKING — READING

Links were made between adjacent grades and grade 8 to Literature. Table 9–3 shows the number of linking items from the lower grade and the upper grade for each link. There were two sets of linking items for each link and direction. For example, in linking grade 5 to grade 6, there were 20 grade 5 items (lower grade) and 20 grade 6 items (upper grade). The number of linking items was the same across grades.

Table 9–3. Reading Linking Item Detail

Link	Lower Grade	Upper Grade	Total
Grade 3 to Grade 4	20	20	40
Grade 4 to Grade 5	20	20	40
Grade 5 to Grade 6	20	20	40
Grade 6 to Grade 7	20	20	40
Grade 8 to Grade 7	20	20	40
Literature to Grade 8	20	20	40

A visual representation of the vertical linking design is provided in Table 9–4.

Table 9–4. Reading Vertical Linking Design of Forms

Gr. 3 Forms	Gr. 4 Forms	Gr. 5 Forms	Gr. 6 Forms	Gr. 7 Forms	Gr. 8 Forms	Lit Forms
Gr. 3 Items (86)	Gr. 3 Items (20)					
Gr. 4 Items (20)	Gr. 4 Items (87)	Gr. 4 Items (20)				
	Gr. 5 Items (20)	Gr. 5 Items (86)	Gr. 5 Items (20)			
		Gr. 6 Items (20)	Gr. 6 Items (210)	Gr. 6 Items (20)		
			Gr. 7 Items (20)	Gr. 7 Items (192)	Gr. 7 Items (20)	
				Gr. 8 Items (20)	Gr. 8 Items (192)	Gr. 8 Items (20)
					Lit Items (20)	Lit Items (348)

See Appendix C for details related to vertical linking items such as *n*-counts, Eligible Content, and diagnostic categories.

VERTICAL LINKING — SCIENCE

Links were made between adjacent grades, grade 8 to Biology, and grade 8 to Chemistry. Table 9–5 below shows the number of linking items from the lower grade and the upper grade for each link. There were two sets of linking items for each link and direction. For example, in linking grade 5 to grade 6, there were 20 grade 5 items (lower grade) and 20 grade 6 items (upper grade). The number of linking items was the same across grades.

Table 9–5. Science Linking Item Detail

Link	Lower Grade	Upper Grade	Total
Grade 3 to Grade 4	20	20	40
Grade 4 to Grade 5	20	20	40
Grade 5 to Grade 6	20	20	40
Grade 6 to Grade 7	20	20	40
Grade 8 to Grade 7	20	20	40
Biology to Grade 8	20	20	40
Chemistry to Grade 8	20	20	40

A visual representation of the vertical linking design is provided in Table 9–6.

Table 9–6. Science Vertical Linking Design of Forms

Gr. 3 Forms	Gr. 4 Forms	Gr. 5 Forms	Gr. 6 Forms	Gr. 7 Forms	Gr. 8 Forms	Bio Forms	Chem Forms
Gr. 3 Items (91)	Gr. 3 Items (20)						
Gr. 4 Items (20)	Gr. 4 Items (123)	Gr. 4 Items (20)					
	Gr. 5 Items (20)	Gr. 5 Items (102)	Gr. 5 Items (20)				
		Gr. 6 Items (20)	Gr. 6 Items (178)	Gr. 6 Items (20)			
			Gr. 7 Items (20)	Gr. 7 Items (327)	Gr. 7 Items (20)		
				Gr. 8 Items (20)	Gr. 8 Items (377)	Gr. 8 Items (20)	Gr. 8 Items (20)
					Gr. 11 Items (115)		
					Bio Items (20)	Bio Items (390)	
					Chem Items (20)		Chem Items (335)

See Appendix C for details related to vertical linking items such as *n*-counts, Eligible Content, and diagnostic categories.

VERTICAL LINKING — WRITING

Links were made between adjacent grades and grade 8 to English Composition. Table 9–7 shows the number of linking items from the lower grade and the upper grade for each link. There were two sets of linking items for each link and direction. For example, in linking grade 5 to grade 6, there were 20 grade 5 items (lower grade) and 20 grade 6 items (upper grade). The number of linking items was the same across grades.

Table 9–7. Writing Linking Item Detail

Link	Lower Grade	Upper Grade	Total
Grade 3 to Grade 4	20	20	40
Grade 4 to Grade 5	20	20	40
Grade 5 to Grade 6	20	20	40
Grade 6 to Grade 7	20	20	40
Grade 8 to Grade 7	20	20	40
English Composition to Grade 8	20	20	40

A visual representation of the vertical linking design is provided in Table 9–8.

Table 9–8. Writing Vertical Linking Design of Forms

Gr. 3 Forms	Gr. 4 Forms	Gr. 5 Forms	Gr. 6 Forms	Gr. 7 Forms	Gr. 8 Forms	Eng Forms
Gr. 3 Items (140)	Gr. 3 Items (20)					
Gr. 4 Items (20)	Gr. 4 Items (149)	Gr. 4 Items (20)				
	Gr. 5 Items (20)	Gr. 5 Items (165)	Gr. 5 Items (20)			
		Gr. 6 Items (20)	Gr. 6 Items (193)	Gr. 6 Items (20)		
			Gr. 7 Items (20)	Gr. 7 Items (176)	Gr. 7 Items (20)	
				Gr. 8 Items (20)	Gr. 8 Items (195)	Gr. 8 Items (20)
					Eng Items (20)	Eng Items (365)

See Appendix C for details related to vertical linking items such as *n*-counts, Eligible Content, and diagnostic categories.

THE VERTICAL LINKING PROCEDURE

Each of the CDT content area vertical scales was centered at grade 7. Adjacent-grade shift parameters were calculated and applied such that all items were vertically linked to grade 7. For example, grade 4 science items were placed on the science vertical scale by applying three shift parameters:

- shift between grades 4 and 5 science
- shift between grades 5 and 6 science
- shift between grades 6 and 7 science

The steps used to calculate adjacent-grade shift parameters are described below. All item calibrations were done with WINSTEPS software version 3.71 (Linacre, 2009). The grade 4 to grade 5 link is provided as an example for the steps.

1. Calibrate all on-grade items.
    - Calibrate grade 4 items on grade 4 forms.
    - Calibrate grade 5 items on grade 5 forms.

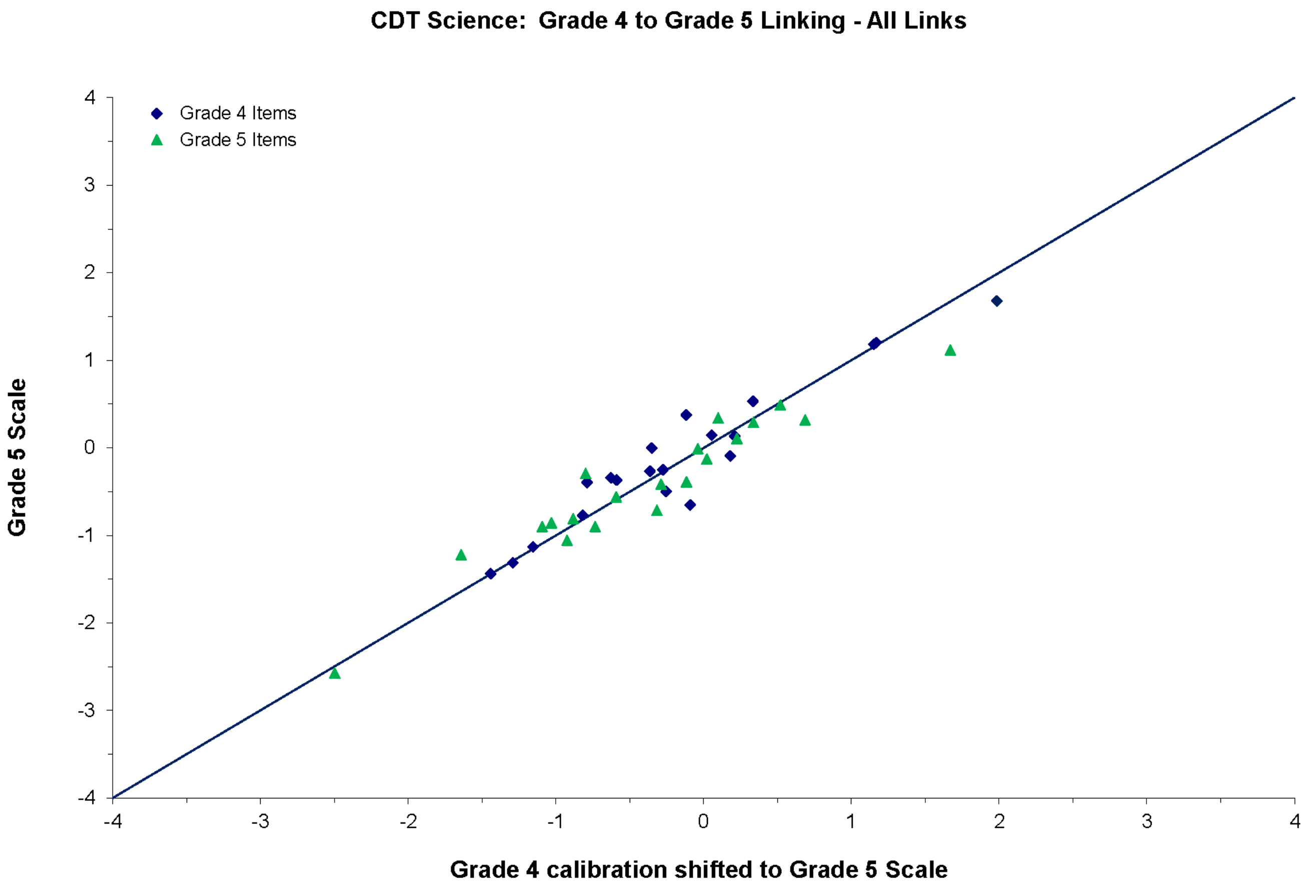
2. Calibrate off-grade items anchoring on the on-grade items. Anchor values come from step 1.
    - Calibrate grade 5 items on grade 4 forms anchoring on item parameters determined in grade 4 calibration in step 1.
    - Calibrate grade 4 items on grade 5 forms anchoring on item parameters determined in grade 5 calibration in step 1.

      Note: For the linking between grades 4 and 5, the calibration of off-grade items on grade 4 forms includes only grade 5 items. It does not include grade 3 items that appeared on grade 4 forms. That is, grade 3 and grade 5 items that appeared on grade 4 forms are not calibrated together.

   For each of the linking items, there are two estimates of item difficulty—one from each of the two calibrations. Correlation between these should be high. If not, vertical linking will be problematic.

3. Calculate the difference between the two estimates of item difficulty from step 2 for each linking item. The average of these differences is the adjacent grade shift parameter.
   - If grade is less than 7, determine the shift parameter needed to place items on upper grade scale.
   - If grade is greater than 7, determine the shift parameter needed to place items on lower grade scale.
   - Calculate the difference in item difficulty estimates between step 2, bullet 1 (grade 4 scale) and step 2, bullet 2 (grade 5 scale). An example of an Excel table used for calculations can be found in Appendix C.
4. Apply the adjacent grade shift parameter and plot the linking items along with a 45° line. Figure 9–1 below is an example. The 45° line is for visual reference only. Outliers are NOT identified by comparing to the line. See step 5 for details.

Figure 9–1. Sample of Linking Items Plot



Plots for all adjacent grade links can be found in Appendix C.

5. Determine if any items should be removed from the vertical linking process. Identify potential outliers using a combination of correlation, ratio of standard deviation, and robust Z. Discuss these items with test development specialists to determine if they should be removed. An item may be removed from the linking process and still remain in the item pool. In this case, the item is not removed from the on-grade calibrations. That is, do not re-run calibrations in step 1. Repeat steps 2 through 4.

6. Calculate the final shift parameter to the base grade (center of scale) by chaining together adjacent grade shift parameters
   - Grade 7 is the base grade. The final shift parameter for grade 4 items is the shift parameter between grades 4 and 5 plus the shift parameter between grades 5 and 6 plus the shift parameter between grades 6 and 7.
7. Apply the final shift parameters in step 6 to the item parameters calibrated in step 1.

VERTICAL LINKING RESULTS

Table 9–9 shows the number of links, correlation, and shift parameter for the both the initial and final vertical linking for each content area. Initial vertical linking includes all items. Final values were determined after some links were dropped after consultation with test development specialists.

Table 9–9. Vertical Linking Summary

Content Area	Link	Number of Links Initial	Number of Links Final	Correlation Initial	Correlation Final	Shift Parameter Initial	Shift Parameter Final
Mathematics	Grade 3 to Grade 4	40	39	0.960	0.964	-1.245	-1.212
Mathematics	Grade 4 to Grade 5	40	40	0.892	0.892	-0.622	-0.622
Mathematics	Grade 5 to Grade 6	50	49	0.914	0.910	-0.416	-0.395
Mathematics	Grade 6 to Grade 7	60	60	0.935	0.935	-0.782	-0.782
Mathematics	Grade 8 to Grade 7	60	60	0.887	0.887	0.301	0.301
Mathematics	Algebra I to Grade 8	60	58	0.933	0.941	0.766	0.808
Mathematics	Algebra II to Algebra I	60	59	0.880	0.905	0.516	0.544
Mathematics	Geometry to Grade 8	60	60	0.907	0.907	1.022	1.022
Reading	Grade 3 to Grade 4	40	40	0.956	0.956	-0.257	-0.257
Reading	Grade 4 to Grade 5	40	38	0.940	0.954	-0.410	-0.348
Reading	Grade 5 to Grade 6	40	39	0.948	0.965	-0.419	-0.389
Reading	Grade 6 to Grade 7	40	37	0.914	0.945	-0.066	-0.092
Reading	Grade 8 to Grade 7	40	40	0.934	0.934	0.352	0.352
Reading	Literature to Grade 8	40	40	0.929	0.929	0.383	0.383
Science	Grade 3 to Grade 4	40	40	0.952	0.952	-0.570	-0.570
Science	Grade 4 to Grade 5	40	40	0.956	0.956	-0.773	-0.773
Science	Grade 5 to Grade 6	40	40	0.968	0.968	-0.211	-0.211
Science	Grade 6 to Grade 7	40	39	0.938	0.945	-0.135	-0.111
Science	Grade 8 to Grade 7	40	40	0.973	0.973	0.140	0.140
Science	Biology to Grade 8	40	38	0.858	0.904	0.815	0.821
Science	Chemistry to Grade 8	40	37	0.882	0.932	1.172	1.136
Writing	Grade 3 to Grade 4	40	40	0.957	0.957	-0.597	-0.597
Writing	Grade 4 to Grade 5	40	40	0.954	0.954	-0.221	-0.221
Writing	Grade 5 to Grade 6	40	40	0.967	0.967	-0.305	-0.305
Writing	Grade 6 to Grade 7	40	40	0.950	0.950	-0.237	-0.237
Writing	Grade 8 to Grade 7	40	40	0.967	0.967	0.221	0.221
Writing	English Composition to Grade 8	40	40	0.961	0.961	0.176	0.176

Recall that for each content area the vertical scale is centered at grade 7. If the item's grade is less than 7, the shift parameter is the value that is added to place the item on the upper grade scale. For example, -1.212 is added to each grade 3 mathematics item's difficulty to place them on the grade 4 scale. The negative sign indicates that grade 3 items are less difficult than grade 4 items. If the item's grade is greater than 7, the shift parameter is the value added to place the item on the lower grade scale. For example, 0.301 is added to each grade 8 mathematics item's difficulty to place them on the grade 7 scale. The positive sign indicates that grade 8 items are more difficult than grade 7 items.

Items dropped from vertical linking are shown in Table 9–10. Linking plots in Appendix C show all linking items with dropped items in red.

Table 9–10. Items Dropped from Vertical Linking

Content Area	Link	Linking Items Removed
Mathematics	Grade 3 to Grade 4	603609 (gr. 4 item)
Mathematics	Grade 4 to Grade 5	None
Mathematics	Grade 5 to Grade 6	602104 (gr. 6 item)
Mathematics	Grade 6 to Grade 7	None
Mathematics	Grade 8 to Grade 7	None
Mathematics	Algebra I to Grade 8	601126 (gr. 8 item) and 602644 (gr. 11 item*)
Mathematics	Algebra II to Algebra I	603086 (Alg II item)
Mathematics	Geometry to Grade 8	None
Reading	Grade 3 to Grade 4	None
Reading	Grade 4 to Grade 5	611272 (gr. 5 item) and 611274 (gr. 5 item)
Reading	Grade 5 to Grade 6	610309 (gr. 6 item)
Reading	Grade 6 to Grade 7	610135 (gr. 6 item), 609022 (gr. 6 item), and 609023 (gr. 6 item)
Reading	Grade 8 to Grade 7	None
Reading	Literature to Grade 8	None
Science	Grade 3 to Grade 4	None
Science	Grade 4 to Grade 5	None
Science	Grade 5 to Grade 6	None
Science	Grade 6 to Grade 7	615238 (gr. 7 item)
Science	Grade 8 to Grade 7	None
Science	Biology to Grade 8	617395 (Bio item) and 617880 (Bio item)
Science	Chemistry to Grade 8	618699 (Chem item), 616511 (Chem item), and 616365 (Chem item)
Writing	Grade 3 to Grade 4	None
Writing	Grade 4 to Grade 5	None
Writing	Grade 5 to Grade 6	None
Writing	Grade 6 to Grade 7	None
Writing	Grade 8 to Grade 7	None
Writing	English Composition to Grade 8	None

*The grade 11 item was embedded on an Algebra I form

The final shift parameters were calculated by summing adjacent grade shift parameters. For example, grade 4 items were placed on the vertical scale by applying the grade 4 to grade 5 shift, the grade 5 to grade 6 shift, and the grade 6 to grade 7 shift. Similarly, Algebra I items were placed on the vertical scale by applying the Algebra I to grade 8 shift and the grade 8 to grade 7 shift. Table 9–11 shows the final shift parameters for each content area.

Table 9–11. Final Vertical Linking Shift Parameters

Content Area	Grade/Course	Shift
Mathematics	Grade 3	-3.011
Mathematics	Grade 4	-1.799
Mathematics	Grade 5	-1.177
Mathematics	Grade 6	-0.782
Mathematics	Grade 7	0.000
Mathematics	Grade 8	0.301
Mathematics	Algebra I	1.109
Mathematics	Geometry	1.323
Mathematics	Algebra II	1.653
Reading	Grade 3	-1.086
Reading	Grade 4	-0.829
Reading	Grade 5	-0.481
Reading	Grade 6	-0.092
Reading	Grade 7	0.000
Reading	Grade 8	0.352
Reading	Literature	0.735
Science	Grade 3	-1.665
Science	Grade 4	-1.095
Science	Grade 5	-0.322
Science	Grade 6	-0.111
Science	Grade 7	0.000
Science	Grade 8	0.140
Science	Biology	0.961
Science	Chemistry	1.276
Writing	Grade 3	-1.360
Writing	Grade 4	-0.763
Writing	Grade 5	-0.542
Writing	Grade 6	-0.237
Writing	Grade 7	0.000
Writing	Grade 8	0.221
Writing	English Composition	0.397

The final vertical linking shift parameters for grade 7 in each content area is zero because it is the base grade. The final vertical linking parameter applied to grade 11 items in mathematics and science is based on the grade or course where the items were field tested. For example, the Algebra I vertical linking constant is applied to grade 11 mathematics items which appeared on Algebra I forms.

BANKED ITEM PARAMETERS FROM STAND-ALONE FIELD TESTS

Table 9–12 provides summary information based on the first stand-alone field-test events which were used to establish the content area vertical scales. The table shows the mean, standard deviation, minimum, and maximum of the item parameter estimates for each grade or course level on the content area vertical scales.

Table 9–12. Summary Statistics for Vertically Scaled Item Parameters from Stand-alone Field Test

Content Area	Grade/Course	Mean	SD	Min	Max
Mathematics	Grade 3	-3.011	1.222	-6.641	0.052
Mathematics	Grade 4	-1.799	1.008	-4.388	0.781
Mathematics	Grade 5	-1.177	1.031	-4.367	1.172
Mathematics	Grade 6	-0.782	1.122	-3.821	2.748
Mathematics	Grade 7	0.000	0.979	-2.385	2.800
Mathematics	Grade 8	0.301	0.939	-2.743	2.985
Mathematics	Grade 11	0.939	1.014	-1.175	3.713
Mathematics	Algebra I	1.109	0.763	-0.888	3.099
Mathematics	Geometry	1.323	0.865	-1.125	3.482
Mathematics	Algebra II	1.653	0.955	-1.377	4.181
Reading	Grade 3	-1.086	1.045	-3.761	1.855
Reading	Grade 4	-0.829	0.944	-3.242	2.177
Reading	Grade 5	-0.481	1.039	-3.201	1.964
Reading	Grade 6	-0.092	1.060	-2.653	3.580
Reading	Grade 7	0.000	1.077	-3.744	3.259
Reading	Grade 8	0.352	1.039	-3.127	3.093
Reading	Literature	0.735	0.929	-2.115	3.313
Science	Grade 3	-1.665	1.302	-5.319	0.813
Science	Grade 4	-1.095	1.145	-4.453	1.663
Science	Grade 5	-0.322	0.948	-2.899	1.683
Science	Grade 6	-0.111	0.971	-2.347	2.546
Science	Grade 7	0.000	0.910	-2.531	2.532
Science	Grade 8	0.140	1.035	-2.654	3.309
Science	Grade 11	0.773	0.892	-2.216	2.377
Science	Biology	0.961	0.867	-1.331	3.731
Science	Chemistry	1.276	0.688	-1.101	3.064
Writing	Grade 3	-1.360	1.196	-4.536	2.958
Writing	Grade 4	-0.763	1.140	-3.608	1.899
Writing	Grade 5	-0.542	1.073	-3.780	2.462
Writing	Grade 6	-0.237	1.052	-2.724	4.390
Writing	Grade 7	0.000	1.132	-2.866	3.593
Writing	Grade 8	0.221	1.120	-3.234	2.883
Writing	English Composition	0.397	1.087	-2.531	3.617

Figures 9–2 through 9–5 show the banked item parameter estimates following the first stand-alone field-test events for each grade or course on the content area vertical scales.

Figure 9–2. Mathematics Item Parameters Estimates from Stand-alone Field Test

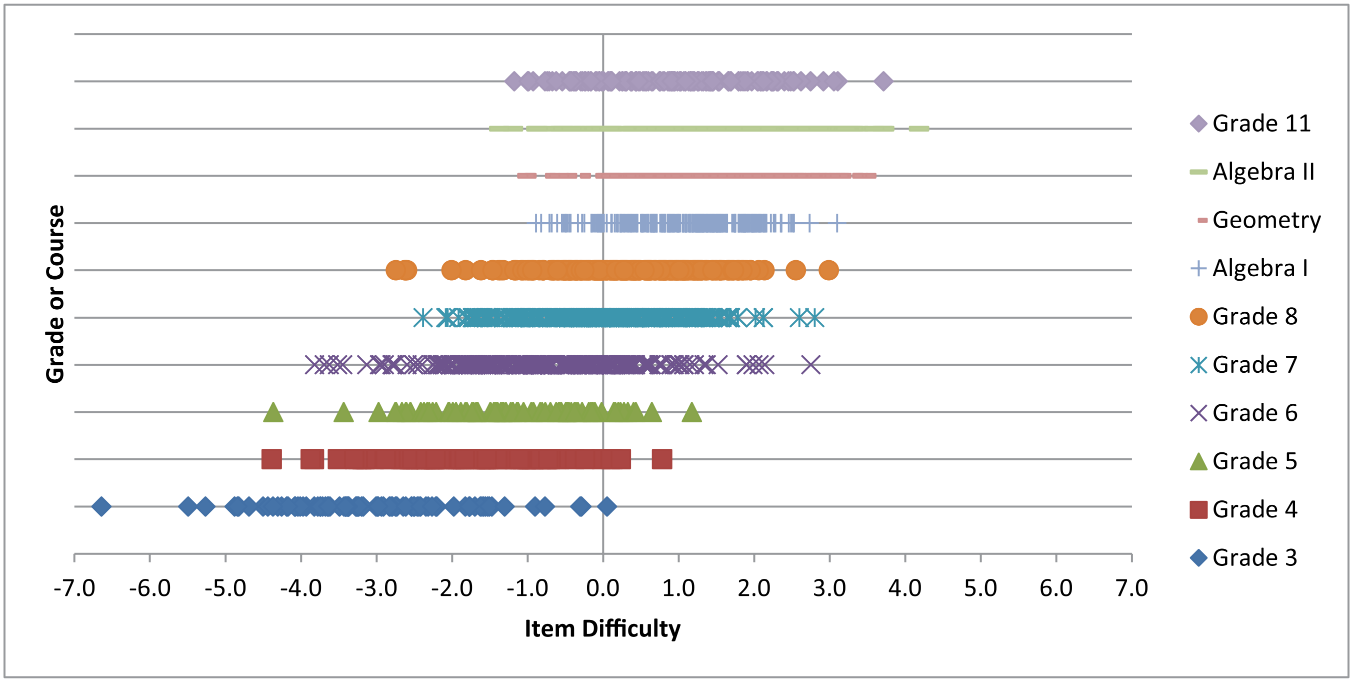


Figure 9–3. Reading Item Parameters Estimates from Stand-alone Field Test

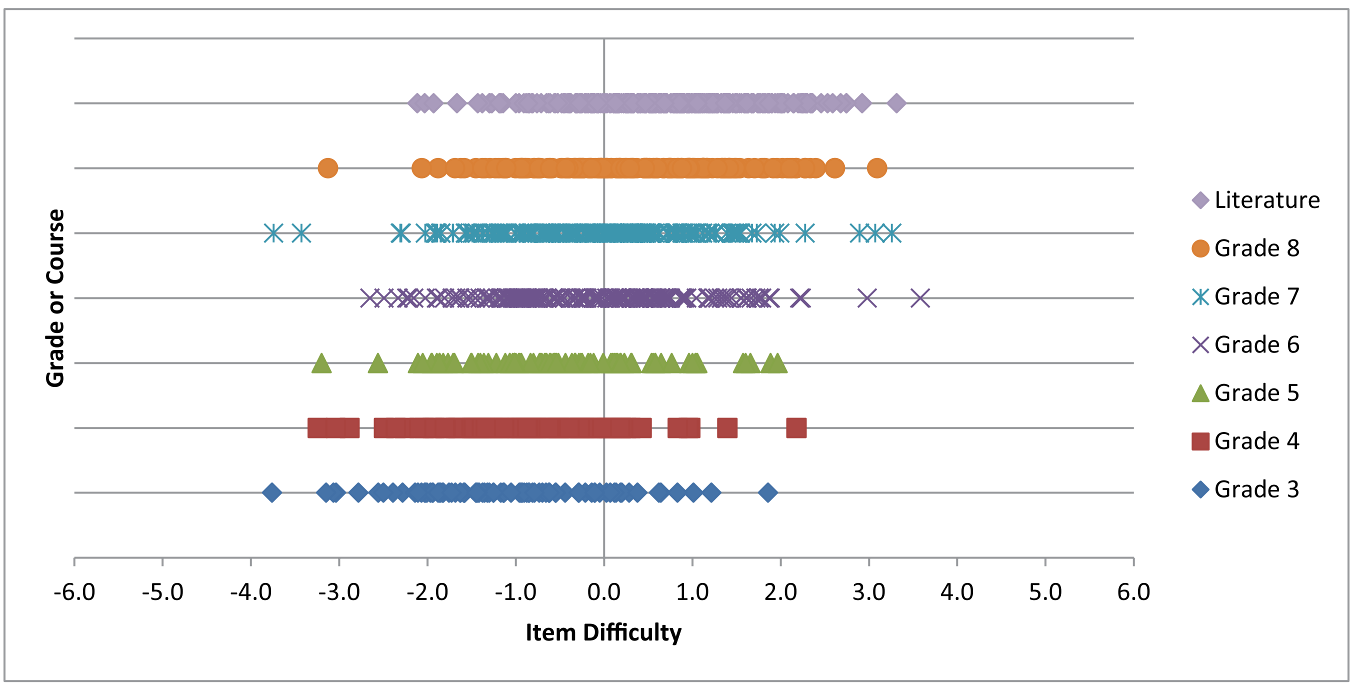


Figure 9–4. Science Item Parameters Estimates from Stand-alone Field Test

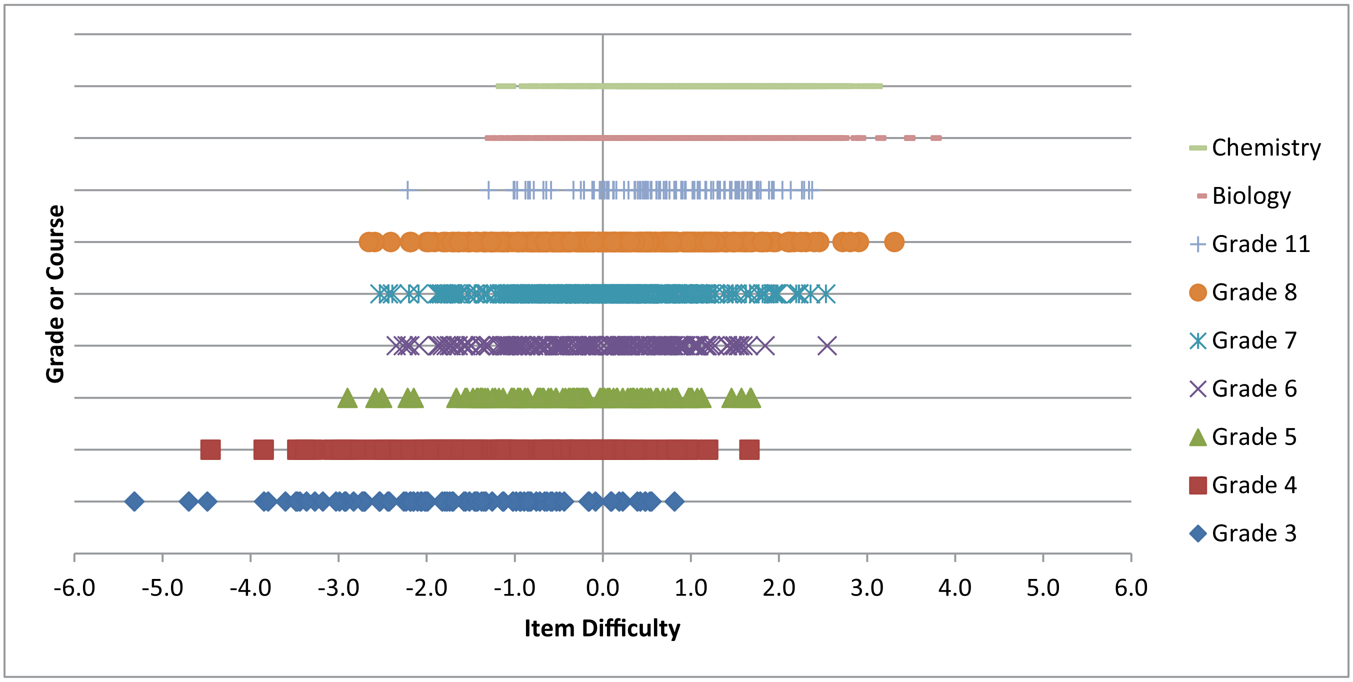
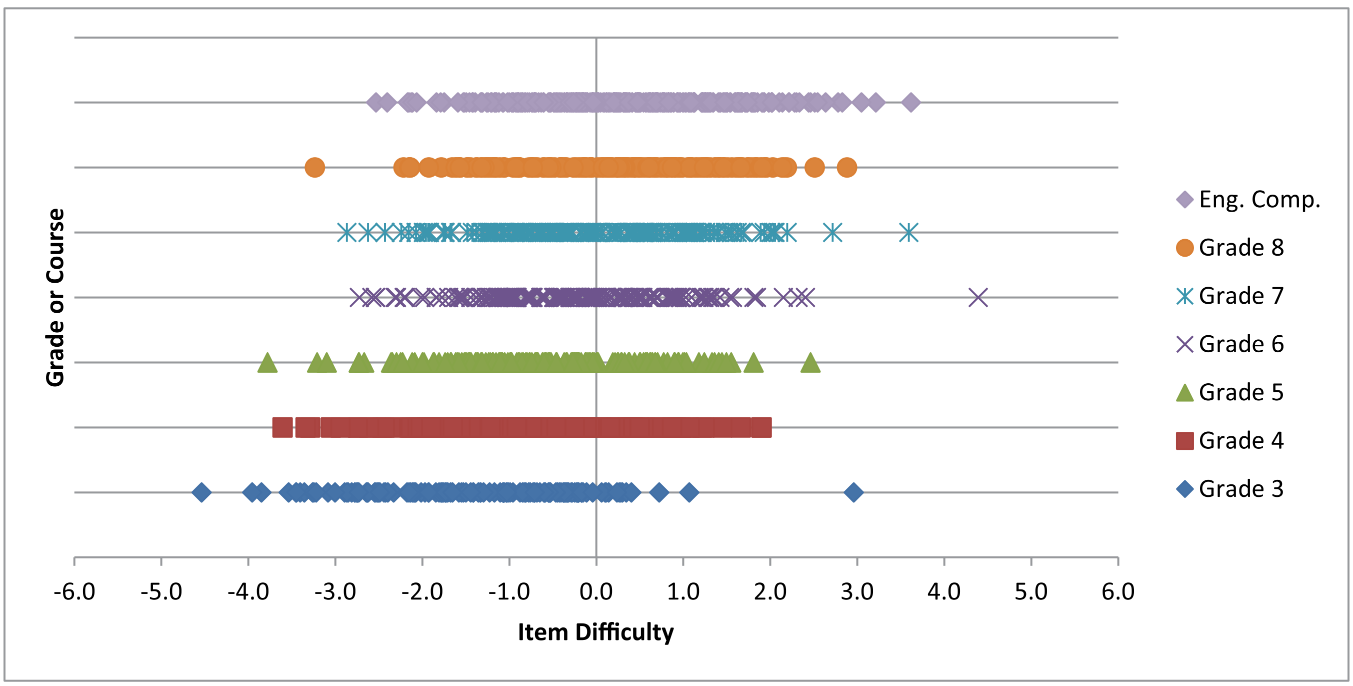


Figure 9–5. Writing Item Parameters Estimates from Stand-alone Field Test



Rasch item difficulty measure on the vertical scale and associated standard error for all items from the initial stand-alone field tests are presented in Appendix B of the 2017–2018 technical report.

BANKED ITEM PARAMETERS FOR THE 2021–2022 OPERATIONAL ITEM POOLS

A number of changes to the CDT item pools have occurred since the initial stand-alone field-test events and creation of the content area vertical scales. For example, there have been embedded field test events to augment the item pools as well as introduce items in kindergarten, grade 1, and grade 2. (See Chapter Six for details on the various field-test events.) Additionally, prior to the 2013–2014 school year CDT items in mathematics, reading, and writing were re-aligned to the new Pennsylvania Core Standards. Table 9–13 provides summary information based on the operational item pools for the 2021–2022 school year. The table shows the mean, standard deviation, minimum, and maximum of the item parameter estimates for each grade or course level on the content area vertical scales.

Table 9–13. Summary Statistics for Vertically Scaled Item Parameters for 2021–2022 School Year

Content Area	Grade/Course	Mean	SD	Min	Max
Mathematics	Kindergarten	-3.914	1.322	-6.433	-0.611
Mathematics	Grade 1	-3.732	1.069	-5.955	-0.610
Mathematics	Grade 2	-2.976	1.346	-5.987	0.402
Mathematics	Grade 3	-1.823	1.246	-5.632	2.158
Mathematics	Grade 4	-1.289	1.239	-6.641	2.748
Mathematics	Grade 5	-0.804	1.038	-3.831	2.139
Mathematics	Grade 6	-0.131	1.124	-3.821	3.389
Mathematics	Grade 7	0.278	0.933	-2.882	2.893
Mathematics	Grade 8	0.589	0.815	-1.662	3.651
Mathematics	Algebra I	0.870	0.794	-1.367	3.264
Mathematics	Geometry	1.193	0.904	-2.058	3.662
Mathematics	Algebra II	1.653	0.916	-1.377	4.181
Reading	Kindergarten	-2.239	1.037	-4.352	0.020
Reading	Grade 1	-1.613	0.995	-4.780	0.831
Reading	Grade 2	-1.148	0.816	-3.869	0.618
Reading	Grade 3	-0.701	0.959	-4.500	1.855
Reading	Grade 4	-0.285	0.975	-3.608	2.464
Reading	Grade 5	0.010	0.884	-3.201	2.101
Reading	Grade 6	0.126	0.917	-2.653	2.578
Reading	Grade 7	0.335	0.909	-3.744	3.259
Reading	Grade 8	0.551	0.916	-3.127	2.799
Reading	Literature	0.825	0.825	-2.115	2.859
Science	Grades K-2 span	-2.265	1.139	-5.446	1.864
Science	Grade 3	-1.691	1.229	-5.319	0.878
Science	Grade 4	-1.095	1.128	-7.111	1.689
Science	Grade 5	-0.512	0.848	-3.108	2.463
Science	Grade 6	-0.237	0.875	-2.723	2.071
Science	Grade 7	-0.094	0.841	-2.531	2.532
Science	Grade 8	0.004	0.921	-2.654	3.309

Table 9–13 (continued). Summary Statistics for Vertically Scaled Item Parameters for 2021–2022 School Year

Content Area	Grade/Course	Mean	SD	Min	Max
Science	Grade 11	0.672	0.944	-2.216	2.391
Science	Biology	0.728	0.805	-1.408	3.731
Science	Chemistry	1.192	0.690	-1.101	3.064
Writing	Kindergarten	-3.121	1.004	-5.685	0.047
Writing	Grade 1	-2.467	1.047	-5.107	0.693
Writing	Grade 2	-1.858	0.878	-4.436	-0.064
Writing	Grade 3	-1.114	1.224	-4.536	2.958
Writing	Grade 4	-0.820	1.177	-4.075	2.137
Writing	Grade 5	-0.663	1.027	-3.780	1.929
Writing	Grade 6	-0.318	0.934	-2.942	3.006
Writing	Grade 7	-0.086	0.862	-2.625	2.194
Writing	Grade 8	0.042	0.926	-3.234	2.192
Writing	English Composition	0.271	0.993	-3.507	3.214

Figures 9–6 through 9–9 show the banked item parameter estimates for the operational item pools for the 2021–2022 school year for each grade or course on the content area vertical scales.

Figure 9–6. Mathematics Item Parameters Estimates for 2021–2022 School Year

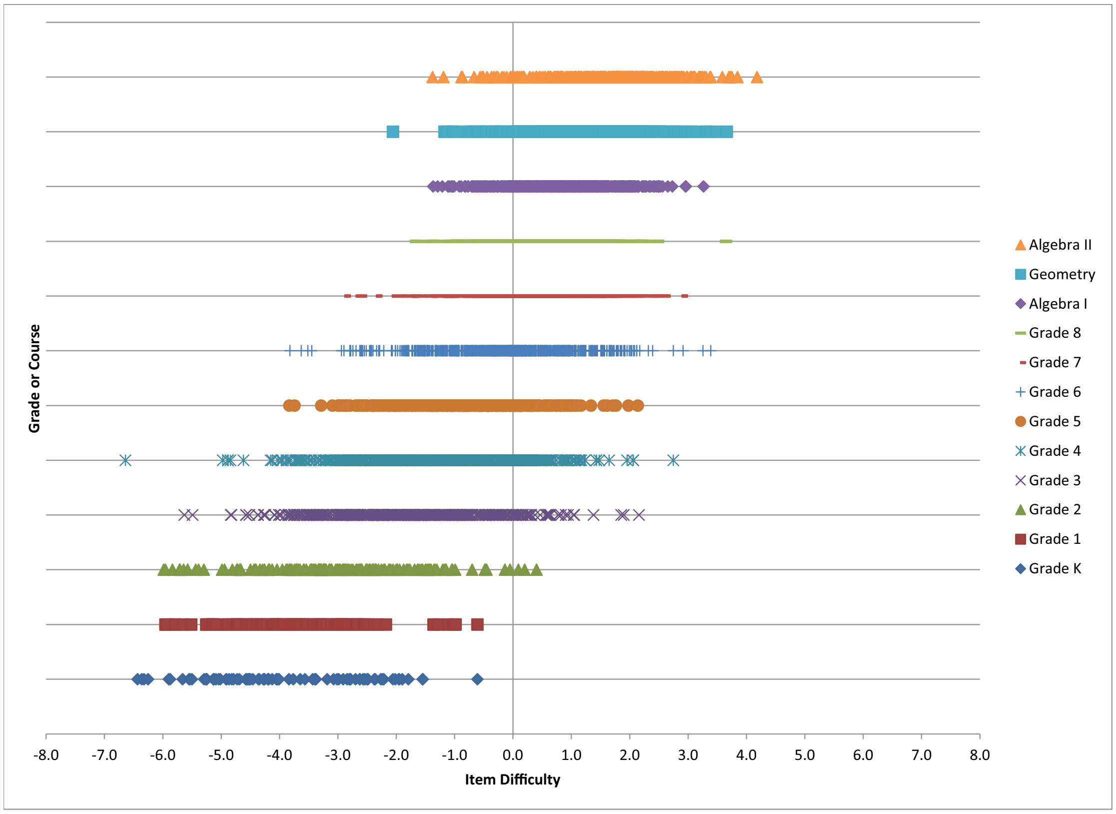


Figure 9–7. Reading Item Parameters Estimates for 2021–2022 School Year

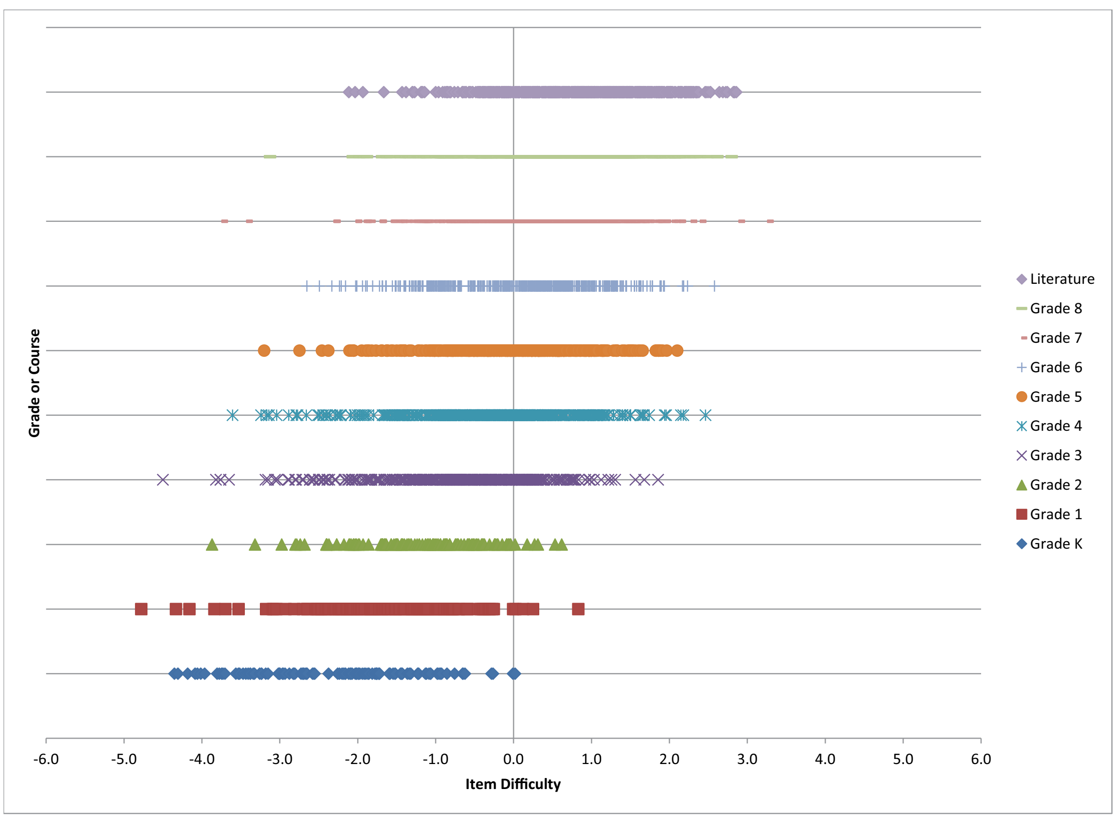


Figure 9–8. Science Item Parameters Estimates for 2021–2022 School Year

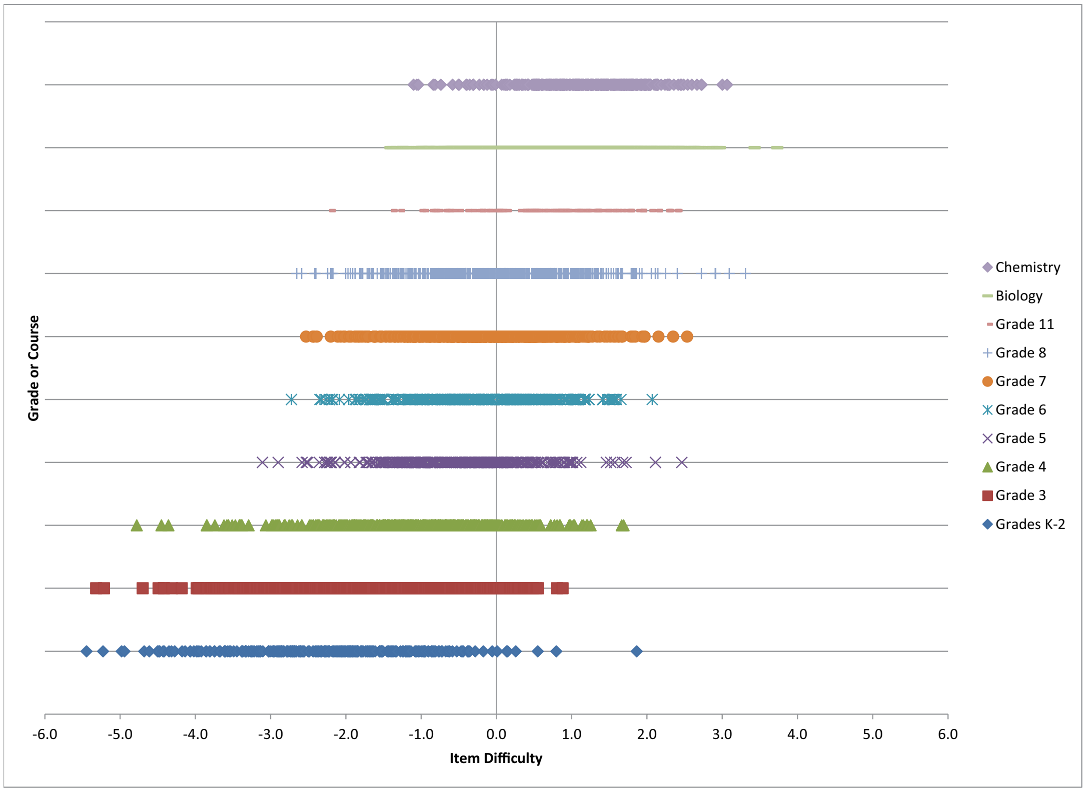
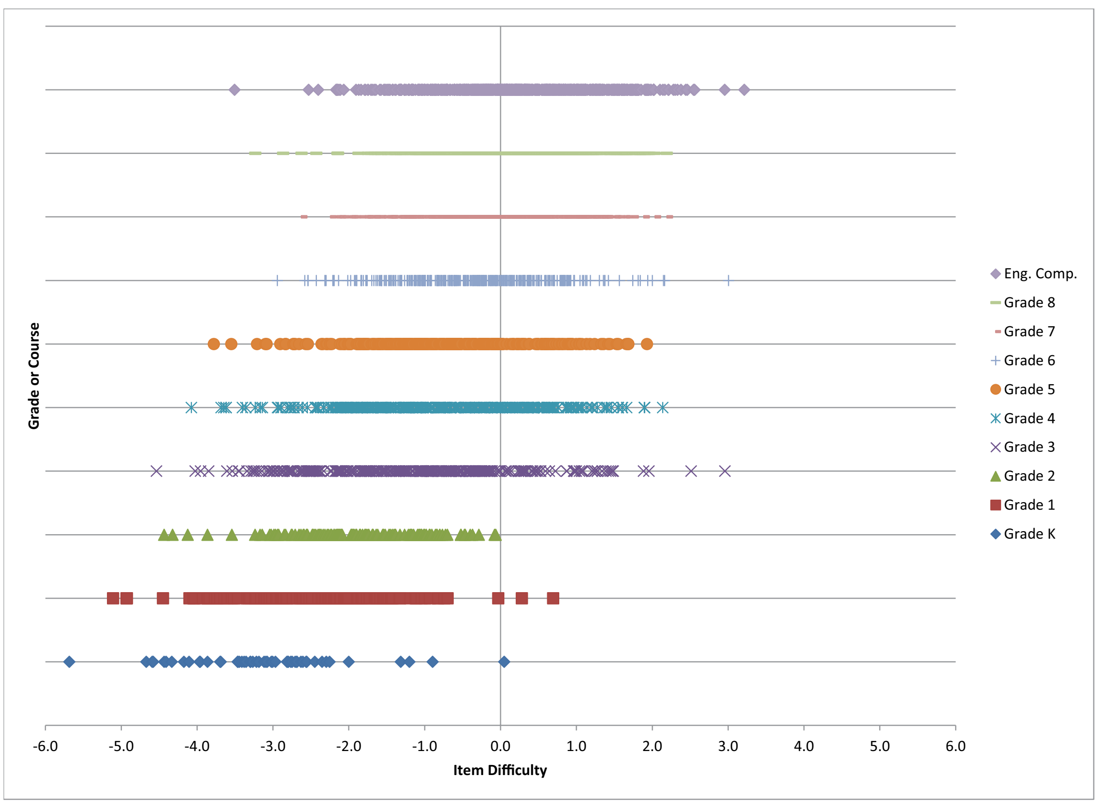


Figure 9–9. Writing Item Parameters Estimates for 2021–2022 School Year



Rasch item difficulty measure on the vertical scale and associated standard error for all operational items are presented in Appendix B of the 2017–2018, 2018–2019, and 2019–2020 technical reports.

CHAPTER TEN: BENCHMARKING

As described in Chapter Fourteen, CDT scores are placed along a continuum from “Areas of Need” to “Strengths to Build On.” These are represented in the dynamic reporting suite with colors red, green, and blue. “Areas of Need” are depicted in the red range, while “Strengths to Build On” are depicted in the green and blue ranges. The center of the green range is the point that separates students into two categories: solidly ready for the next grade or course and not solidly ready for the next grade or course. In each content area, the center of the green range for grades 5 and above was established by panels of Pennsylvania educators during benchmarking activities[1].

BENCHMARKING ACTIVITIES

Table 10–1 below presents general information about the preliminary benchmarking activities for mathematics, reading, science, and writing. The cut points established are considered preliminary because they were set prior to the first operational administration of the CDT. This was necessary so teachers and students would have access to immediate scores and reports following operational administration. As operational data become available, preliminary cut points are reevaluated and possibly revised (see Chapter Nineteen for details including the benchmark cuts in place for the 2021–2022 school year).

Table 10–1. General Information about CDT Benchmarking Activities

Category	Information
Event Date	Mathematics: August 12–13, 2010
Event Date	Reading: January 27–28, 2011
Event Date	Science: January 27–28, 2011
Event Date	Writing: August 4–5, 2011
Grades/Courses	Mathematics: Grades 5–8, High School, Algebra I, Geometry, Algebra II
Grades/Courses	Reading: Grades 5–8, Literature
Grades/Courses	Science: Grades 5–8, High School, Biology, Chemistry
Grades/Courses	Writing: Grades 5–8, English Composition
Methodology	Randomly Ordered Item Booklet (ROIB) Angoff (Yes/No) Method
Categories	Not solidly ready for the next grade or course
Categories	Solidly ready for the next grade or course
Number of Panelists	Mathematics: 28
Number of Panelists	Reading: 23
Number of Panelists	Science: 20
Number of Panelists	Writing: 46
Rounds	Two

There were three separate CDT benchmarking events because the operational CDT was rolled out in phases by content area. Each benchmarking event followed the initial stand-alone field-test event for that content area.

When initially launched, the CDT was available to students in grades 6 and above. However, cut points were established for grades 5 and above. This is because CDT is available throughout the school year. Early in the school year it may be more appropriate to evaluate a student’s scores based on the prior grade cut. For example, in October, a teacher may choose to evaluate a grade 6 student’s scores relative to the grade 5 cut.

[1] The center of the green range for grades 2 through 4 was extrapolated from grades 5 and above prior to the launch of each CDT for students in grades 3 through 5 in spring of 2014. See Chapter Nineteen for details.

The Randomly Ordered Item Booklet (ROIB) Angoff (Yes/No) method was used to set CDT benchmark cut points. Panels of educators worked in grade/course groups to establish cut points for grades 5 through 8, high school, and content area courses Algebra I, Geometry, Algebra II, Literature, Biology, Chemistry, and English Composition. After a training session describing the process and definition of roles, a discussion was held in which panelists were asked to describe what "solidly ready for the next grade or course" means. Thereafter, panelists were asked to review approximately 40 test questions and make individual yes/no judgments as to whether a "solidly ready" student would be successful in answering each question. The judgments were made over two iterations or rounds with a sequence of Round 1 judgments, show and verification of Round 1 results, group discussion, and Round 2 judgments.

After cut points were set for each grade and course within a content area, the vertical articulation of cut points across grades and courses was reviewed. Given that each content area is vertically scaled, it was expected that cut points would increase as grade increased. For example, the grade 8 cut point would not be lower than the grade 7 cut point on the vertical scale. In some cases, post-smoothing was required to ensure increasing cut points across grades/courses and smooth transitions.

Complete descriptions of each benchmarking activity including post-smoothing are available in TAC documents:

- Classroom Diagnostic Tools—Results for Preliminary Benchmarking Activity—Mathematics
- Classroom Diagnostic Tools—Results for Preliminary Benchmarking Activity—Reading and Science
- Classroom Diagnostic Tools—Results for Preliminary Benchmarking Activity—Writing

BENCHMARKING RESULTS

Preliminary cut points in the logit metric for each content area are shown in Figures 10–1 through 10–4. In general, the difference between cut points is greater in the lower grades and then levels off.

Figure 10–1. Preliminary Benchmark Cut Points for Mathematics

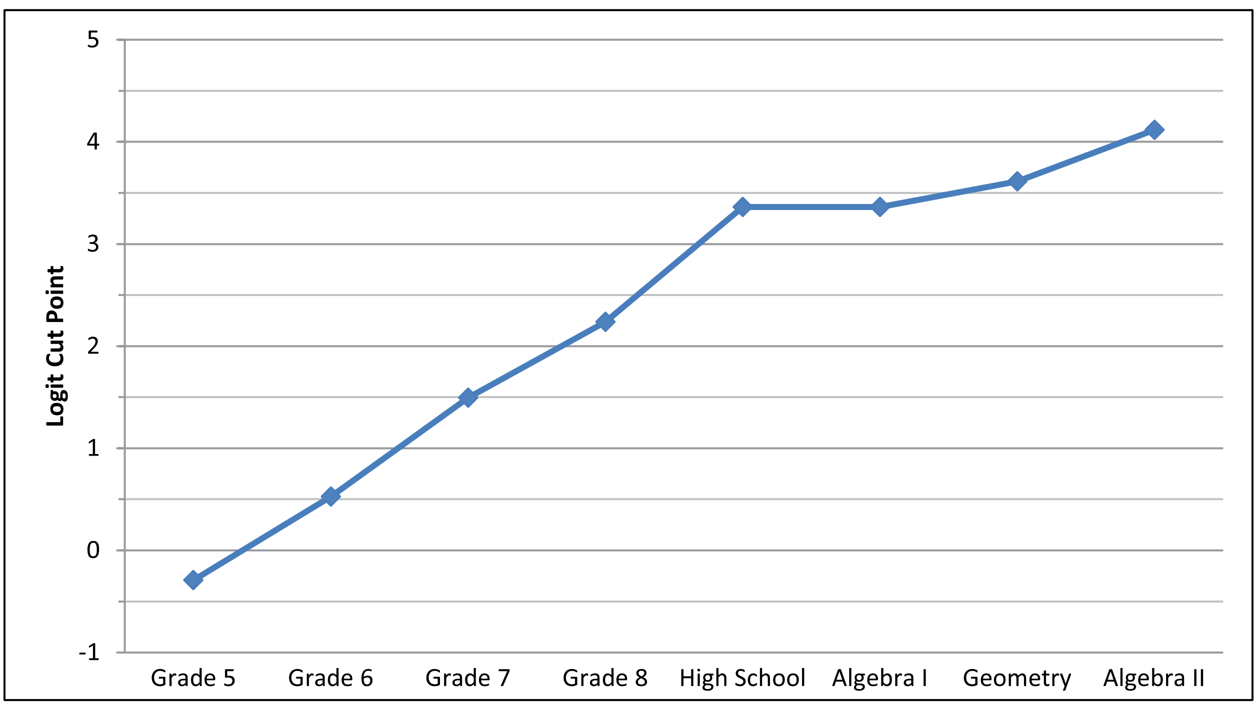


Figure 10–2. Preliminary Benchmark Cut Points for Reading

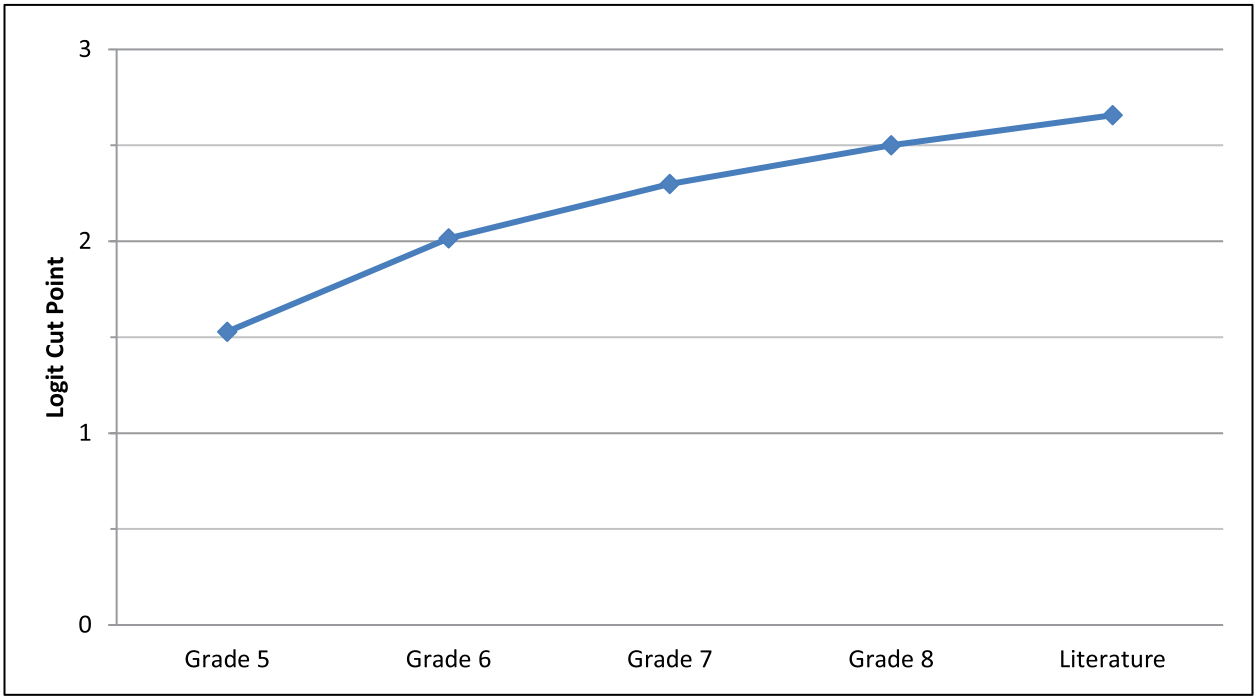


Figure 10–3. Preliminary Benchmark Cut Points for Science

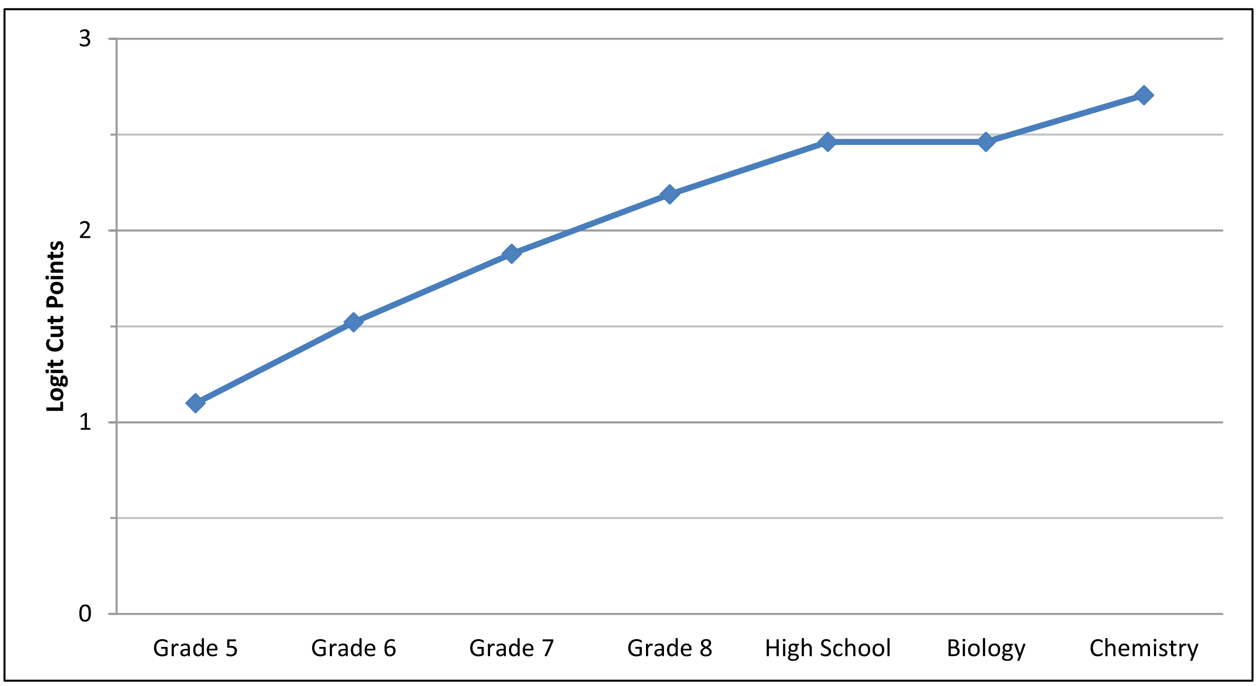


Figure 10–4. Preliminary Benchmark Cut Points for Writing

Table 10–2 shows the preliminary benchmark cuts in the logit metric for each content area. Also presented are the scale score ranges for each color on the CDT reports.

Table 10–2. Preliminary Benchmark Cuts and Scale Score Ranges

Content Area	Grade or Course	Logit Cut Point (Center of Green)	Red Scale Score Range	Green Scale Score Range	Blue Scale Score Range
Mathematics	Grade 5	-0.292	400 - 895	896 - 1058	1059 - 2000
Mathematics	Grade 6	0.526	400 - 997	998 - 1160	1161 - 2000
Mathematics	Grade 7	1.495	400 - 1118	1119 - 1281	1282 - 2000
Mathematics	Grade 8	2.238	400 - 1211	1212 - 1374	1375 - 2000
Mathematics	High School	3.363	400 - 1351	1352 - 1514	1515 - 2000
Mathematics	Algebra I	3.363	400 - 1351	1352 - 1514	1515 - 2000
Mathematics	Geometry	3.614	400 - 1383	1384 - 1546	1547 - 2000
Mathematics	Algebra II	4.117	400 - 1446	1447 - 1609	1610 - 2000
Reading	Grade 5	1.529	400 - 982	983 - 1197	1198 - 2000
Reading	Grade 6	2.015	400 - 1051	1052 - 1266	1267 - 2000
Reading	Grade 7	2.299	400 - 1092	1093 - 1307	1308 - 2000
Reading	Grade 8	2.500	400 - 1121	1122 - 1336	1337 - 2000
Reading	Literature	2.657	400 - 1143	1144 - 1358	1359 - 2000
Science	Grade 5	1.099	400 - 1009	1010 - 1182	1183 - 2000
Science	Grade 6	1.522	400 - 1066	1067 - 1239	1240 - 2000
Science	Grade 7	1.879	400 - 1113	1114 - 1286	1287 - 2000
Science	Grade 8	2.189	400 - 1154	1155 - 1327	1328 - 2000
Science	High School	2.462	400 - 1190	1191 - 1363	1364 - 2000
Science	Biology	2.462	400 - 1190	1191 - 1363	1364 - 2000
Science	Chemistry	2.706	400 - 1223	1224 - 1396	1397 - 2000
Writing	Grade 5	0.731	400 - 959	960 - 1132	1133 - 2000
Writing	Grade 6	1.363	400 - 1043	1044 - 1216	1217 - 2000
Writing	Grade 7	1.886	400 - 1113	1114 - 1286	1287 - 2000
Writing	Grade 8	2.219	400 - 1157	1158 - 1330	1331 - 2000
Writing	English Composition	2.281	400 - 1166	1167 - 1339	1340 - 2000

CHAPTER ELEVEN: SCALING

Scaling is used to transform test score values onto a scale that can be interpreted by users easily and correctly. Raw scores cannot be used to compare students' achievement on the CDT because they depend on the difficulty of the test items administered. Given the adaptive nature of the CDT, each student receives test items targeted at his or her level of achievement. Therefore, two students may have taken very different sets of items in terms of difficulty but have the same raw score. This makes use of raw scores for comparison across students, across administrations, or to a specific standard (cut point) meaningless. Rasch ability estimates in the logit metric do take into consideration the difficulty of the items administered. Therefore, they may be used to make comparisons. However, scale scores are introduced to report CDT results since scale scores may be easier to understand and interpret than logits.

Essentially, CDT scale scores are derived through a two-step process. First, there is a nonlinear transformation that converts an individual raw score on a unique set of items to Rasch ability (in logits). Second, a linear transformation is used to convert logits to scale scores. These and some additional considerations (e.g., rounding rules) are discussed in more detail below.

RAW SCORES TO RASCH ABILITY ESTIMATES

For each CDT test, the calibrated item difficulties associated with the unique set of items administered were used to obtain Rasch person ability estimates and asymptotic standard errors of measurement for the overall test, as well as each diagnostic category. Calibrated item difficulties were based on the field tests and vertical linking (further discussed in Chapter Eight and Chapter Nine).

Raw scores (total and diagnostic category) on the unique set of items that makes up an individual CDT test were mapped to Rasch ability estimates using unconditional, joint-maximum likelihood estimation. In the case of zero or perfect raw scores, a fractional raw score (a value less than one) was added to zero scores and subtracted from perfect scores to determine the corresponding logit values for these extreme scores. The Rasch ability estimates were then transformed to scale scores as discussed in the next section.

RASCH ABILITY ESTIMATES TO SCALE SCORES

Generally, scale scores are preferred over Rasch ability estimates for reporting purposes. One issue is that Rasch ability estimates are on a scale that includes negative and decimal values. By transforming the Rasch ability estimates to scale scores, all reported values can become positive integers, which makes more sense to teachers, parents, and students. Since Rasch ability estimates are comparative, the transformed scale scores have a common scale across administrations.

Scale scores are usually obtained through some linear transformation of Rasch ability estimates. Before the linear equation was established for each content area, a few points were considered for the CDT:

- Avoid scales that might be confused with scores for other types of assessment; for example:
  - Scale scores ranging from 0 to 100 (because this might be confused with percent correct scores or percentile ranks)
  - Scale scores ranging from 200 to 800 (because this might be confused with SAT scores)
  - Scale scores with similar ranges as the ones for the Pennsylvania System of School Assessment (PSSA) or Keystone Exams
- Avoid scales similar to raw scores.
- Avoid scales that might suggest the scores are more precise than they actually are (in other words, suggesting more precision than can be supported by the test scores).
- Avoid scales with negative numbers and decimals.

In terms of industry standard practice, a common perspective is that scale scores should facilitate score interpretation while at the same time minimize misinterpretation and unwarranted inferences. Often this is done by incorporating some kind of meaning to the scores[1] (Peterson, Kolen, and Hoover, 1989). The incorporation of content meaning is one way to facilitate score interpretation. This might be done in several different ways. For example, PSSA scaled scores, like those of many other state assessments, try to input some content meaning by having the PSSA performance level cut scores have known values on the scaled score metric. Such an approach appears to make good sense given the purposes of the criterion-reference test like the PSSA.

For CDT, the scale must be sufficiently large to cover the entire vertical scale. As a result, an initial scale score range of 400 to 2000 was established for each content area. When CDT was expanded in spring of 2014 and made available to students in grades 3 through 5, the scale score range was expanded to 200 to 2000 for those students. Initially, the grade 7 benchmark logit cut point was mapped to a scale score of 1200 for all content areas. It is worth noting that, although careful consideration was given to the selection of these values, they are completely arbitrary. For example, the label of 1200 could have been called 100 or any other value without affecting any of the relationships among schools, administrations, students, or items. In other words, changing the scale would simply be changing the labels on the axis of a graph without moving any of the points.

LINEAR TRANSFORMATION FORMULAS

The scale scores for the CDT for each content area are obtained through a linear transformation of the Rasch ability estimates ($\hat{\beta}$). Specifically,

$$SS = m\hat{\beta} + b,$$

where *m* is the slope and *b* is the intercept. The linear transformation for each CDT content area was derived by anchoring the grade 7 benchmark cut (i.e., Rasch ability estimate) to the scale score 1200 and a Rasch ability estimate of 7.9 to the scale score of 2000. The slopes of the scaling equations influence the variability of the scale scores. It is important that the slopes are sufficiently large to cover the full range of the vertical scale. The CDT scaling equations produce scale score distributions with standard deviations of approximately 150 scale score points and cover logit ranges of approximately -6.5 to 7.9. The final slopes and intercepts for deriving scale scores for the CDT are provided in Table 11–1.

Table 11–1. Scaling Constants by Content Area

Content Area	Slope	Intercept
Mathematics	124.90	1013.30
Reading	142.83	871.63
Science	132.87	950.34
Writing	133.02	949.12

ROUNDING

The linearly transformed scale scores are rounded to the nearest integer value for reporting purposes. Values greater than or equal to 0.50 are rounded up. Values less than 0.50 are rounded down.

[1] Not everyone agrees with this sentiment. Some have argued the opposite point—that is, any attempt to add meaning to test scores actually predisposes the scores to be misinterpreted (see Angoff, 1984).

LOWEST OBTAINABLE SCALE SCORES

Each general content area CDT (mathematics, reading, science, and writing) has a lowest obtainable scale score (LOSS) of 200. Course specific CDTs (Algebra I, Geometry, Algebra II, Biology, and Chemistry) have a lowest obtainable scale score (LOSS) of 400. Any derived scale score less than LOSS is truncated to this minimum value. The selection of a LOSS is mainly based on two considerations:

1. Extremely low scale scores may have an impact on the average of the scale scores if CDT data is summarized at school, district, or state level.
2. Score truncation makes sense from a score precision perspective given measurement errors at the extremes are large.

HIGHEST OBTAINABLE SCALE SCORES

A highest obtainable scale score (HOSS), 2000, is set for the CDT for the same reasons as described for the LOSS value.

CHAPTER TWELVE: EQUATING

Equating is a statistical process that is used to adjust scores on test forms so that scores on the forms can be used interchangeably (Kolen & Brennan, 2004), even though the test forms consist of different items. In the case of the CDT, the adaptive nature of the test means that each student takes a unique test form with items targeted at his or her level of achievement.

To make meaningful comparisons of test scores across administrations, various equating models and procedures have been developed in the literature. For example, in terms of design, there are randomly equivalent groups design and common-item non-equivalent groups design. In terms of testing model, the model can be classified as either classical test theory based equating model or modern test theory (e.g., Rasch model or item response theory) based equating model. In terms of when the equating is conducted in the assessment cycle, the model can be classified as pre-equating or post-equating.

Given the requirements of adaptive testing and immediate score reporting, CDT is pre-equated. Also, it was based on the Rasch model. The following sections will focus on the discussion of pre-equating and the equating design for the CDT.

PRE-EQUATING VERSUS POST-EQUATING

Like other Pennsylvania assessment programs, the CDT uses the Rasch model to guide test design, calibration, scaling, and equating. The key element of equating test forms using the Rasch model is to place the item parameters on the same scale. Once this is done, raw scores can be converted to Rasch ability estimates and then to scale scores as described in Chapter Eleven. As a result, the scale scores can be compared across forms and administrations with different items.

A common practice in many K–12 large-scale assessment programs is to have all the items field tested before they are administered in an operational setting. Once the field-test items' difficulties are placed on the base scale or common metric, in theory, one should not expect the Rasch item difficulties for these items to change, except within a reasonable range of measurement error, after they are administered in an operational test, providing the Rasch model fits the data. Based on this theoretical advantage of using Rasch models, equating can be conducted using the item parameters calibrated from field-test data. This statistical procedure is referred to as pre-equating. In contrast, post-equating involves the use of Rasch item difficulties calibrated from the data of the operational test to be equated.

Although, in theory, the two equating procedures should provide identical results when the model fits the data, each of them has its own advantages and disadvantages. The use of pre-equating can facilitate the operational process in terms of adaptive item selection, rapid or immediate score reporting, and more flexibility in the assessment. However, a variety of issues need to be considered when using pre-equating in practice. For example, students may not be motivated to take the field tests, especially stand-alone field tests, which may make the items appear harder in the field test than in the operational test (Eignor, 1985; Eignor and Stocking, 1986; Stocking and Eignor, 1986; Kolen and Harris, 1990). Other concerns for the field-test items include item context, item position, and sample size. In contrast, the use of post-equating, when applicable, does not have the same motivational concerns because students cannot distinguish between operational and field-test items. Also, post-equating is sometimes considered to yield more accurate analysis results given the large number of students who take the operational tests. On the other hand, post-equating does not allow for adaptive item selection or immediate score reporting as required of the CDT.

EQUATING DESIGN FOR THE CDT

The CDT is an adaptive test, meaning that the test items selected are tailored to each student's achievement as the test progresses. This requires that all items in the pool be on the same scale and known at the time of testing. For CDT, this is accomplished by vertical linking the entire item pool within a content area based on the field-test events. See Chapter Eight and Chapter Nine for details. The known (pre-equated) item parameters are used in selecting items targeted for the student and to provide immediate scores to teachers and students.

In implementing the pre-equating model for the CDT, efforts were made to enhance the accuracy of pre-equating results. To address the concerns on students' motivation to take field tests, records were excluded from item calibrations if the student did not answer at least 5 questions. Also, records with high person outfit mean-squares values were excluded following the WINSTEPS suggestion that these may be the result of a few random responses by low performers. To address concerns of sample sizes, windows for field testing were scheduled so they did not overlap other testing in an attempt to increase volunteer participation. Also, field-test windows were extended in cases where schools were unable to complete testing in the allotted time. A small study of mathematics vertical linking items revealed no position effects. However, it should be noted that with adaptive tests students do not take the same items. Even if two students do take the same item, it will likely not be in the same test position.

EVALUATION OF ITEM PARAMETER STABILITY

After each school year, item parameter stability studies are conducted for each content area. If the differences between the newly estimated Rasch item difficulties and the estimates based on the field-test events are not statistically significant, the pre-equating results should be valid. See Chapter Eighteen for results of item parameter stability studies based on operational data from the 2021–2022 school year.

EQUATING ADDITIONAL FIELD-TEST ITEMS

Over time, additional items have been, and will continue to be, needed to replenish the CDT item pools. Plans to field test additional items must include an equating plan. Equating is needed to place the new items onto the existing vertical scale. In the case of stand-alone field-test events, common-item equating was used. That is, field-test forms included items from the current CDT item pool. In the case of embedded field-test events, field-test items were included within an operational administration such that students did not know which items were field test. With both stand-alone and embedded field test, equating was accomplished by running the calibration of field-test items with item parameters of operational items fixed/anchored to the bank values using WINSTEPS. For each content area, the entire item pool, including field-test items, was calibrated using WINSTEPS with operational items anchored on the banked values.

CHAPTER THIRTEEN: OPERATIONAL TEST DESIGN AND CAT CONFIGURATIONS

The Pennsylvania Classroom Diagnostic Tools (CDT) was initially developed to support teachers and students in grades 6 through 12. In spring 2014, CDT was made available to students in grades 3 through 5 as well. The tools are fully integrated and aligned in the Standards Aligned System (SAS) and enable educators to identify students' academic strengths and areas of need as well as provide links to classroom resources. The assessment is voluntary and administered completely online using a computer adaptive test (CAT) model.

The CDT features a number of tests. Tests in Mathematics, Algebra I, Geometry, and Algebra II were introduced in October 2010 for students in grades 6 and above. Tests in Reading/Literature, Science, Biology, and Chemistry were first available in April 2011 for students in grades 6 and above. Tests in Writing /English Composition began in October 2011 for students in grades 6 and above. Tests in Mathematics, Reading, Science, and Writing for students in grades 3 through 5 started in April 2014.

This chapter details the operational CDT test design and configuration of the CAT algorithm. Test design elements include the number of diagnostic categories, the number of operational items to administer per diagnostic category, and the number of embedded field-test items. CAT algorithm elements include entry point, item selection criteria, test navigation, and termination.

OPERATIONAL TEST DESIGN

NUMBER OF DIAGNOSTIC CATEGORIES

The CDT tests include multiple-choice (MC) and evidence-based selected-response (EBSR) items. All items in the content areas of mathematics, reading, and writing are aligned to the Pennsylvania Core Standards. All items in the content area of science are aligned to the Pennsylvania Academic Standards. Each CDT is broken into four or five diagnostic categories and the items in the pool are grouped by these diagnostic categories based on the Assessment Anchors and Eligible Content. The diagnostic categories for each of the CDT tests are listed below.

Math Grades 3–5 and Math Grades 6–HS

- Numbers & Operations
- Algebraic Concepts
- Geometry
- Measurement, Data, and Probability

Algebra I

- Operations with Real Numbers and Expressions
- Linear Equations & Inequalities
- Functions & Coordinate Geometry
- Data Analysis

Geometry

- Geometric Properties
- Congruence, Similarity, & Proofs
- Coordinate Geometry & Right Triangles
- Measurement

Algebra II

- Operations with Complex Numbers
- Non-Linear Expressions & Equations
- Functions
- Data Analysis

Reading Grades 3–5 and Reading/Lit Grades 6–HS

- Key Ideas and Details—Literature Text
- Key Ideas and Details—Informational Text
- Craft and Structure/Integration of Knowledge and Ideas—Literature Text
- Craft and Structure/Integration of Knowledge and Ideas—Informational Text
- Vocabulary Acquisition and Use

Science Grades 3–5 and Science Grades 6–HS

- The Nature of Science
- Biological Sciences
- Physical Sciences
- Earth/Space Sciences

Biology

- Basic Biological Principles/Chemical Basis for Life
- Bioenergetics/Homeostasis & Transport
- Cell Growth & Reproduction/Genetics
- Theory of Evolution/Ecology

Chemistry

- Properties & Classification of Matter
- Atomic Structure & The Periodic Table
- The Mole & Chemical Bonding
- Chemical Relationships & Reactions

Writing Grades 3–5 and Writing/Eng Comp Grades 6–HS

- Quality of Writing: Focus and Organization
- Quality of Writing: Content and Style
- Quality of Writing: Editing
- Conventions: Punctuation, Capitalization, and Spelling
- Conventions: Grammar and Sentence Formation

NUMBER OF ITEMS PER DIAGNOSTIC CATEGORY

There were various factors considered when determining the number of operational items to administer per diagnostic category. The goal of the CDT is to provide diagnostic information. Therefore, the test must include a sufficient number of items to provide meaningful scores with low standard errors. However, testing time is limited and the item pools are finite. A very long test may produce lower standard errors, but if it is considered to be "too long" will teachers use it? Also, the longer the test, the more the items are exposed.

Prior to the launch of the first operational CDT in fall of 2010, simulations were run of various test lengths. Table 13–1 shows the average conditional standard error of measurement (CSEM) for total test and each diagnostic category[1] (DC) for five test lengths in simulations of CDT Mathematics. Also included is the theoretical minimum standard error that is possible for each test length. This is the standard error if the ability is known and there are sufficient items to administer where the item's difficulty is equal to the known ability and the test constraints are met.

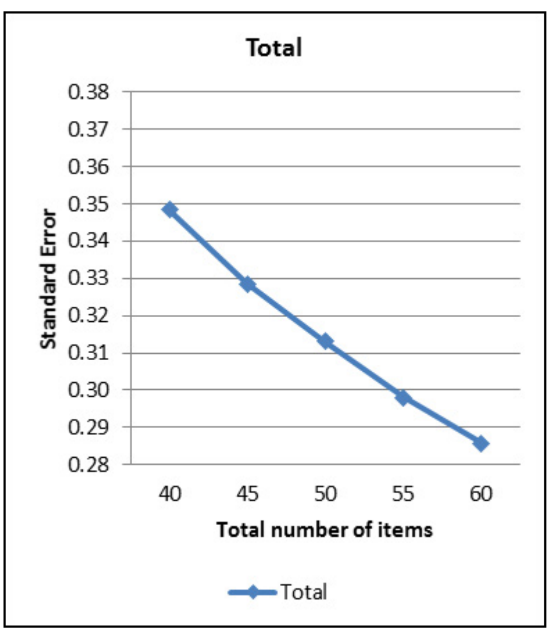
Table 13–1. Average Standard Errors for Various Test Lengths — Mathematics

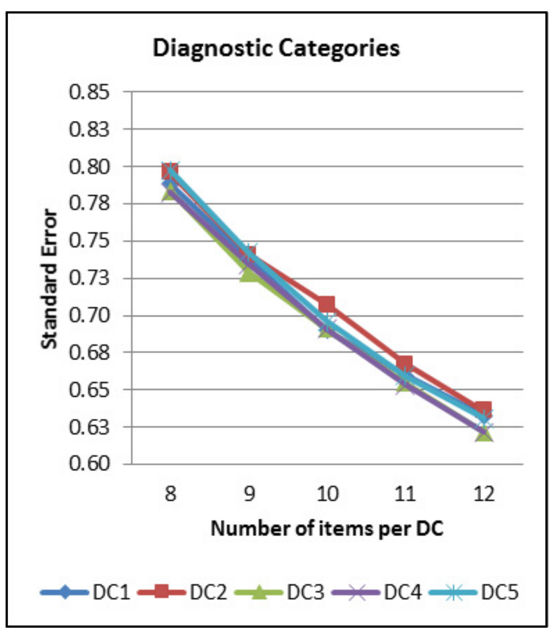
Total Number of Points	Total Min Error	Total Avg Error	Diagnostic Categories Number of Points	Diagnostic Categories Min Error	Diagnostic Categories DC1 Avg Error	Diagnostic Categories DC2 Avg Error	Diagnostic Categories DC3 Avg Error	Diagnostic Categories DC4 Avg Error	Diagnostic Categories DC5 Avg Error
40	0.316	0.348	8	0.707	0.789	0.796	0.784	0.783	0.798
45	0.298	0.329	9	0.667	0.738	0.741	0.729	0.734	0.742
50	0.283	0.313	10	0.632	0.690	0.707	0.691	0.691	0.696
55	0.270	0.298	11	0.603	0.660	0.667	0.655	0.653	0.659
60	0.258	0.286	12	0.577	0.633	0.636	0.622	0.622	0.631

As expected, increasing the number of items decreases the standard error. Differences in standard errors at the diagnostic category level for the same number of items are a reflection of differences in the diagnostic category item pools.

Figure 13–1 shows average standard errors as a function of test length.

Figure 13–1. Average Standard Errors for Various Test Lengths – Mathematics





[1] At that time, there were five diagnostic categories in CDT Mathematics.

Considering test time factors and simulation results for various test lengths, it was determined that CDT tests with four diagnostic categories would have 12–15 items per category (48–60 items total) and CDT tests with five diagnostic categories would have 10–12 items per category (50–60 items total).

NUMBER OF EMBEDDED FIELD-TEST ITEMS

Over time, additional items will be needed to replenish the CDT item pools. Embedding field-test items within an operational CDT test is advantageous for two reasons. First, sufficient item level data can be gathered without the time and expense of a separate stand-alone administration. Second, it allows the new items to be placed on the existing operational scale. See Chapter Twelve for details.

As detailed in Chapter Six, there have been five embedded field-test events. Starting on February 14, 2013, field-test items were embedded within CDT Mathematics and Reading/Literature tests. Starting on August 26, 2013, items were embedded within CDT Mathematics, Reading/Literature, Science, and Writing/English Composition tests for students in grade 6. Starting on August 24, 2015, items were embedded within seven of the thirteen CDTs: Math Grades 6–HS, Algebra I, Reading Grades 3–5, Reading/Lit Grades 6–HS, Science Grades 6–HS, Biology, and Writing/Eng Comp Grades 6–HS. Starting on August 20, 2018, items were embedded within all thirteen of the CDTs. Starting on August 19, 2019, items were embedded within all CDTs in the science content area except Chemistry.

For each embedded field-test event, the factors considered when determining the number of field-test items to embed included the number of items to be field tested, the expected number of students testing, and the desired n-count per item for field-test analyses. In mathematics, science, and writing, field-test items were randomly assigned to fixed positions spread throughout the operational test. In reading, a field-test passage was randomly assigned near the middle of the test and students took all of the items associated with the passage. In all content areas, the positions of field-test items were unknown to students. Field-test items were not clustered at the end of the test in an effort to avoid any fatigue effect when placing the items on the operational scale.

CAT ALGORITHM

This section covers elements of the CAT algorithm including entry point, item selection criteria, test navigation, and termination.

ENTRY POINT

All CDT tests other than Reading Grades 3–5 and Reading/Lit Grades 6–HS begin with a small “locator” section in which one or two items per diagnostic category are administered. The order of the diagnostic categories is random. The two CDT tests in the reading content area are slightly different because they are passage-based. Those, too, have a small “locator” section, but they may not contain one or two items for each diagnostic category because not all passages have an item for each diagnostic category.

The CAT algorithm is designed to administer items targeted for the individual student based on performance. However, student performance in the current test setting is not known at the beginning of the test. With no prior information about a student, the starting point in each diagnostic category is an item of average difficulty. For CDT tests that are not course-specific (Math Grades 3–5, Math Grades 6–HS, Reading Grades 3–5, Reading/Lit Grades 6–HS, Science Grades 3–5, Science Grades 6–HS, Writing Grades 3–5, and Writing/Eng Comp Grades 6–HS), the student’s grade is considered in selecting an item of average difficulty. For example, a grade 7 student taking CDT Math Grades 6–HS will start with an item near the average difficulty of grade 7 items in the pool. For CDT tests that are course-specific (Algebra I, Geometry, Algebra II, Biology, and Chemistry), an average item will be selected regardless of the student’s grade. For example, a grade 7 student taking CDT Algebra I will start with an item near the average difficulty of Algebra I items in the pool.

If a student has previously taken the CDT, the prior CDT scores are used to give the CAT algorithm a “head start.” In this case, the first item in each diagnostic category is selected to match the characteristics of the prior information rather than an average item. For example, if a student previously took the CDT Math Grades 6–HS test and scored very high in “Measurement, Data, and Probability,” then the first item selected in that diagnostic category will be more difficult than the grade level average.

The CAT algorithm includes a randomization component when selecting items to control item exposure. That is, one item is selected from among a set of items that are near the targeted item difficulty. This is especially important at the beginning of the CDT when no prior information is available. Randomization of items and diagnostic categories ensure that students will not see the same set of items in the same order even when all of the students are assigned items of average difficulty.

ITEM SELECTION CRITERIA

Once the initial set of items has been administered, the CAT algorithm is designed to administer items targeted for the individual student based on performance. In targeting items, the CAT algorithm uses Rasch ability estimates from the current test session and considers a number of factors including test blueprint, response probability, item pool refinement, and passage-related concerns. Each of these is discussed in detail on the following pages.

RASCH ABILITY ESTIMATES

As described in Chapter Eight and Chapter Nine, CDT item pools are scaled using the Rasch partial credit model (Wright & Masters, 1982) and vertically linked across grades and courses. The CAT algorithm has access to all item parameters in the item pool. After each item response, Rasch ability estimates and standard errors are calculated via maximum likelihood estimation (MLE) for the total test and each diagnostic category. In the case of zero (all items incorrect) and perfect (all items correct) scores, a correction factor is applied before computing the relevant maximum likelihood estimates. A fractional value is added to a zero score and subtracted from a perfect score before estimation.

After the locator section of the CDT, but before a student has taken many items in each diagnostic category, the total Rasch ability estimate is used in item selection. This is because total and diagnostic category ability estimates tend to be highly correlated, and the total estimate does not change as dramatically as diagnostic category estimates given one additional item. Using the total estimate at this point prevents students from experiencing extreme fluctuations in the difficulty of items.

While use of the total Rasch ability estimate makes sense early in the test, the goal of the CDT is to be diagnostic, and some students exhibit clear strengths and areas of need in different diagnostic categories. Therefore, after four or five items have been administered in a diagnostic category, the corresponding Rasch ability estimate for that diagnostic category is used in item selection. This ensures, for example, that a student struggling in “Biological Sciences” while at the same time excelling in “Earth and Space Sciences” will be administered easier “Biological Sciences” items and more challenging “Earth and Space Sciences” items.

TEST BLUEPRINT

The CAT algorithm closely resembles a modified constrained CAT (MCCAT) design (Leung, Chang, & Hau, 2003). The general idea is that the CAT algorithm is configured with upper and lower bounds that specify the minimum and maximum numbers of items that will be administered to students for both total and diagnostic categories.

RESPONSE PROBABILITY

No matter which Rasch ability estimate is used in selecting an item, total or diagnostic category estimate, the CAT algorithm targets items where the student has response probability (RP) of answering correctly, based on the Rasch ability estimate and item’s difficulty. The most efficient way to run a CAT is to select items where RP is 0.5. That is, select items where the student has a 50% chance of getting the item correct. This response probability produces the smallest standard error for any given number of items.

Prior to the launch of the first operational CDT in fall of 2010, simulations were run for various response probabilities. Table 13–2 shows the average person standard errors for total test and each diagnostic category[2] for seven response probabilities in simulations of CDT Mathematics with 50 items. Figure 13–2 shows average standard errors as a function of response probability.

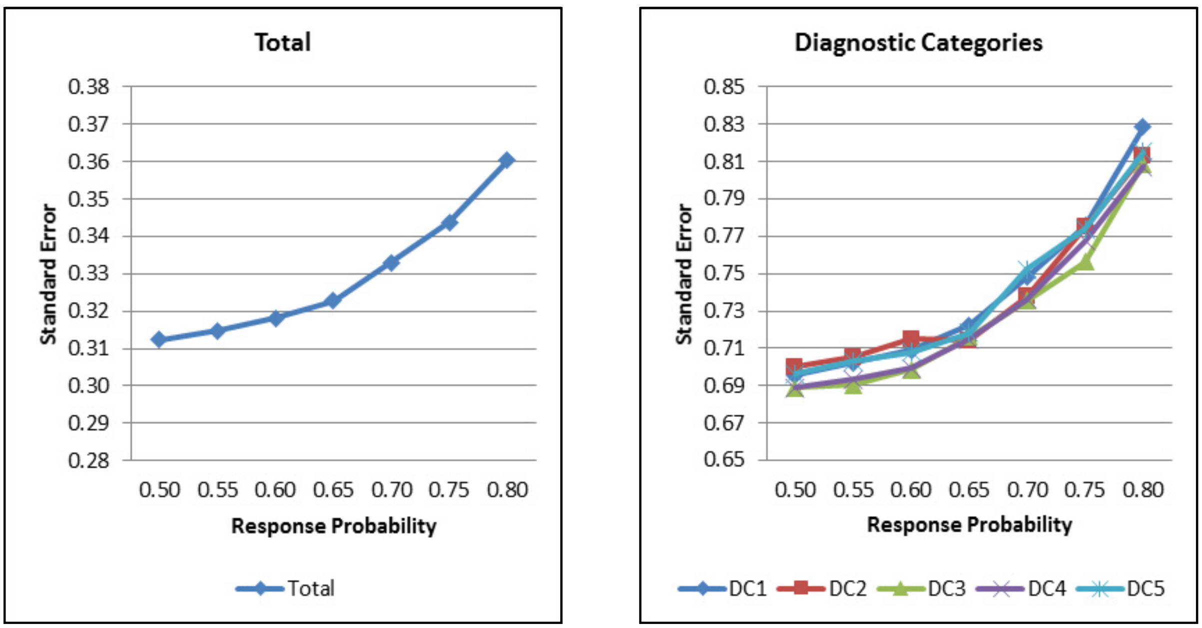
[2] At that time, there were five diagnostic categories in CDT Mathematics.

Table 13–2. Average Standard Errors for Various Response Probabilities — Mathematics

Number of Items	Response Probability	Total	DC 1	DC 2	DC 3	DC 4	DC 5
50 total (10 per DC)	0.50	0.312	0.696	0.700	0.689	0.689	0.696
50 total (10 per DC)	0.55	0.315	0.702	0.705	0.690	0.693	0.703
50 total (10 per DC)	0.60	0.318	0.709	0.715	0.699	0.699	0.708
50 total (10 per DC)	0.65	0.323	0.722	0.714	0.716	0.715	0.719
50 total (10 per DC)	0.70	0.333	0.748	0.738	0.735	0.736	0.752
50 total (10 per DC)	0.75	0.344	0.776	0.775	0.756	0.767	0.774
50 total (10 per DC)	0.80	0.360	0.829	0.813	0.809	0.807	0.815

As expected, increasing the response probability increases the standard error. Differences in standard errors at the diagnostic category level for the same response probability are a reflection of differences in the diagnostic category item pools.

Figure 13–2. Average Standard Errors for Various Response Probabilities — Mathematics



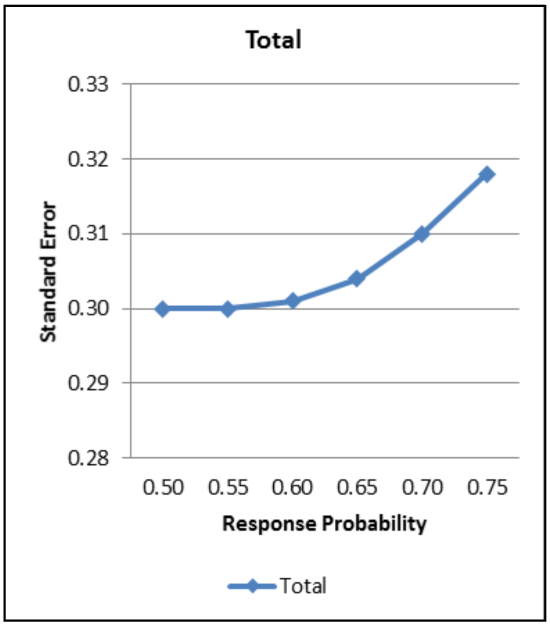
As can be seen in Figure 13–2, increasing response probability incrementally from 0.50 leads to increases in standard error. The increase in standard error is gradual at first and becomes more pronounced around 0.65.

Prior to the launch of the CDT for students in grades 3 through 5, the topic of response probability was revisited for each content area. Simulations for various response probabilities were run with fixed length tests equal to average test length. Results for each content area are presented in Tables 13–3 through 13–6 and Figures 13–3 through 13–6.

Table 13–3. Average Standard Errors for Various Response Probabilities — Mathematics

Number of Items	Response Probability	Total	DC 1	DC 2	DC 3	DC 4
52 total (13 per DC)	0.50	0.300	0.602	0.592	0.601	0.606
52 total (13 per DC)	0.55	0.300	0.602	0.594	0.602	0.607
52 total (13 per DC)	0.60	0.301	0.605	0.597	0.604	0.610
52 total (13 per DC)	0.65	0.304	0.613	0.608	0.613	0.619
52 total (13 per DC)	0.70	0.310	0.626	0.622	0.625	0.631
52 total (13 per DC)	0.75	0.318	0.646	0.644	0.645	0.651

Figure 13–3. Average Standard Errors for Various Response Probabilities — Mathematics



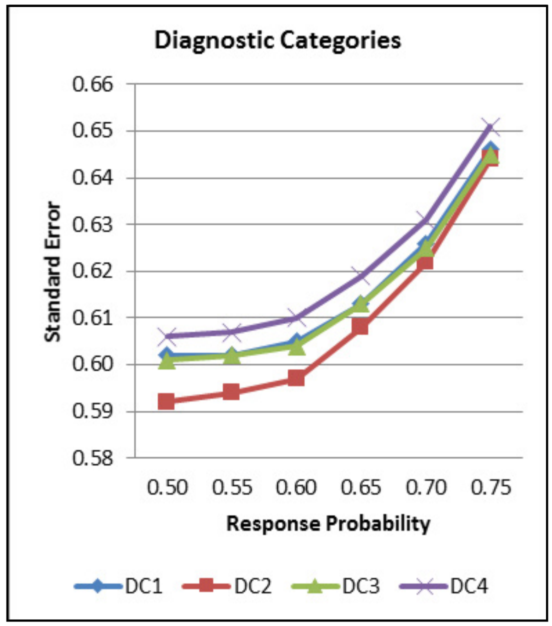
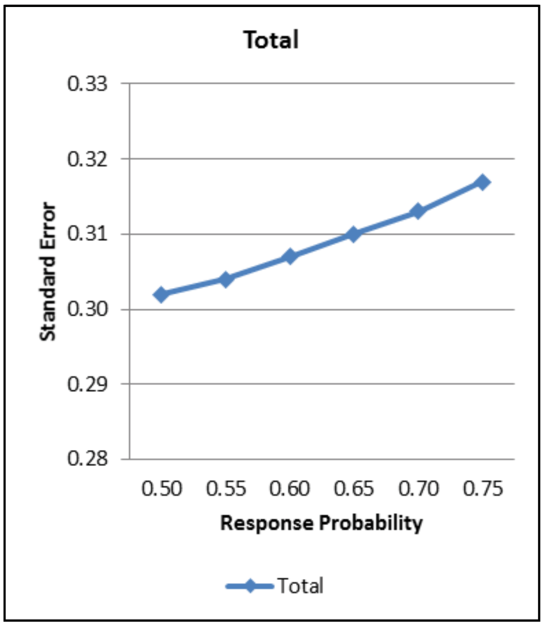


Table 13–4. Average Standard Errors for Various Response Probabilities — Reading

Number of Items	Response Probability	Total	DC 1	DC 2	DC 3	DC 4	DC 5
55 total (11 per DC)	0.50	0.302	0.738	0.739	0.723	0.743	0.743
55 total (11 per DC)	0.55	0.304	0.739	0.744	0.731	0.741	0.751
55 total (11 per DC)	0.60	0.307	0.742	0.744	0.733	0.756	0.771
55 total (11 per DC)	0.65	0.310	0.747	0.751	0.742	0.766	0.781
55 total (11 per DC)	0.70	0.313	0.755	0.756	0.751	0.772	0.800
55 total (11 per DC)	0.75	0.317	0.767	0.762	0.764	0.784	0.823

Figure 13–4. Average Standard Errors for Various Response Probabilities — Reading



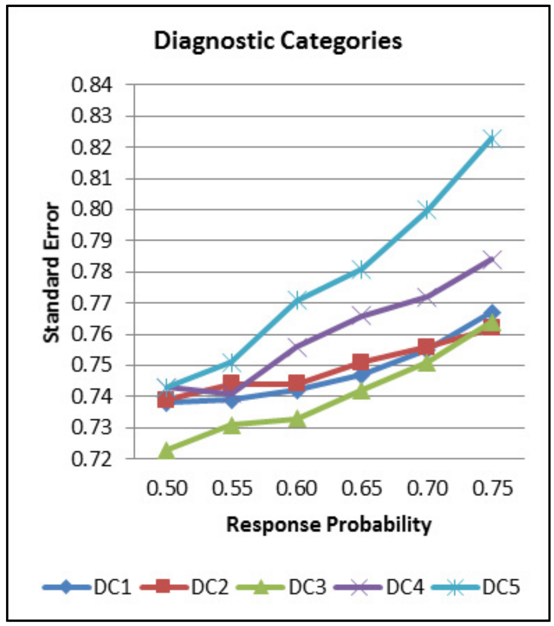
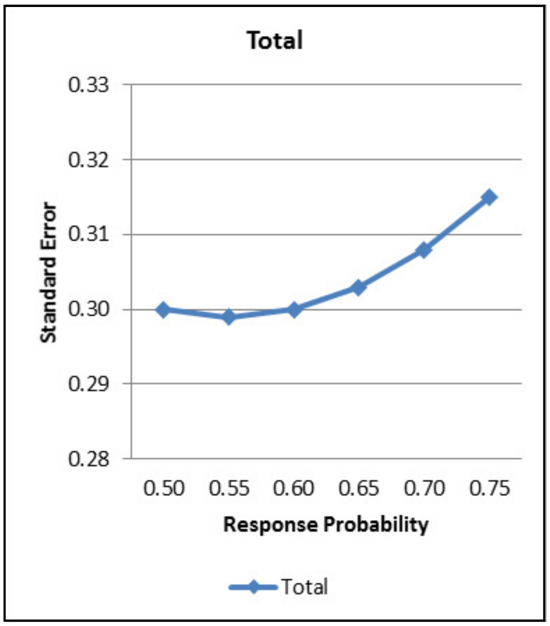


Table 13–5. Average Standard Errors for Various Response Probabilities — Science

Number of Items	Response Probability	Total	DC 1	DC 2	DC 3	DC 4
52 total (13 per DC)	0.50	0.300	0.601	0.599	0.602	0.599
52 total (13 per DC)	0.55	0.299	0.600	0.599	0.600	0.599
52 total (13 per DC)	0.60	0.300	0.602	0.601	0.603	0.604
52 total (13 per DC)	0.65	0.303	0.612	0.608	0.609	0.611
52 total (13 per DC)	0.70	0.308	0.624	0.622	0.619	0.626
52 total (13 per DC)	0.75	0.315	0.642	0.642	0.636	0.644

Figure 13–5. Average Standard Errors for Various Response Probabilities — Science



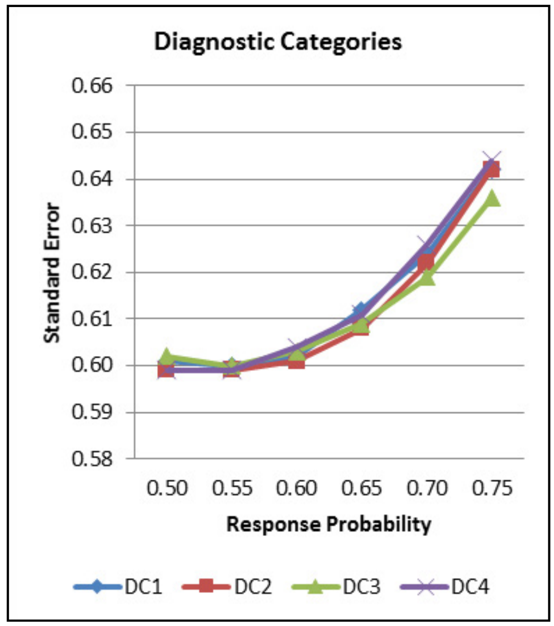
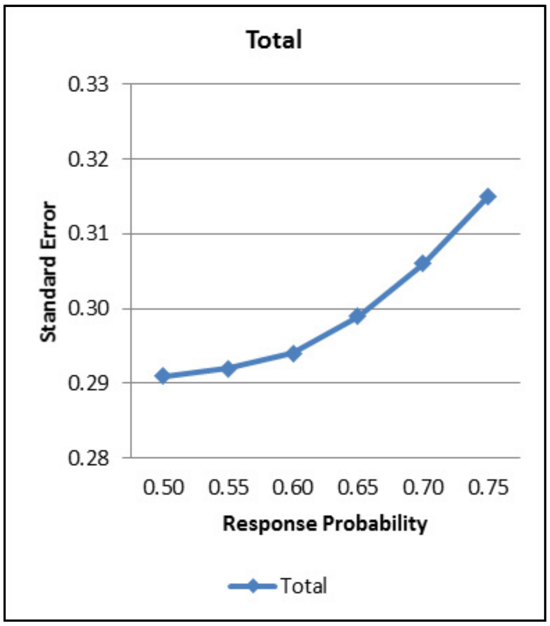
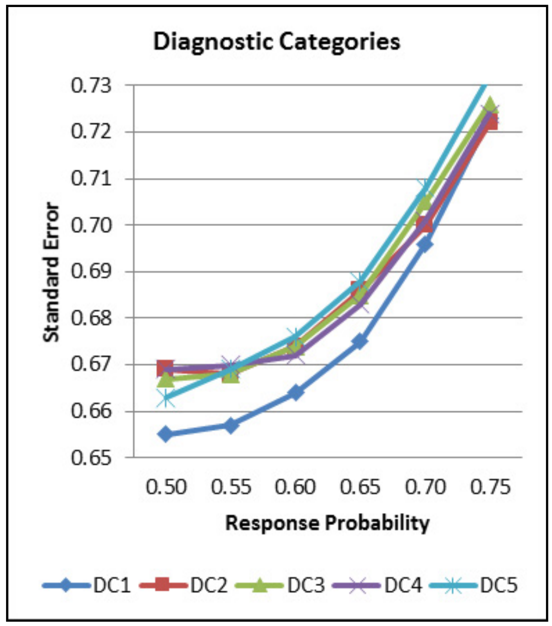


Table 13–6. Average Standard Errors for Various Response Probabilities — Writing

Number of Items	Response Probability	Total	DC 1	DC 2	DC 3	DC 4	DC 5
52 total (13 per DC)	0.50	0.291	0.655	0.669	0.667	0.669	0.663
52 total (13 per DC)	0.55	0.292	0.657	0.668	0.668	0.670	0.669
52 total (13 per DC)	0.60	0.294	0.664	0.674	0.674	0.672	0.676
52 total (13 per DC)	0.65	0.299	0.675	0.686	0.685	0.683	0.688
52 total (13 per DC)	0.70	0.306	0.696	0.700	0.705	0.701	0.708
52 total (13 per DC)	0.75	0.315	0.723	0.722	0.726	0.724	0.732

Figure 13–6. Average Standard Errors for Various Response Probabilities — Writing





Again, increasing response probability incrementally from 0.50 leads to increases in standard error. The increase in standard error is gradual at first and becomes more pronounced around 0.65.

For CDT tests designed for students in grade 6 and above, the response probability is set at 0.5. This is based on the desire for low standard errors at the diagnostic category level and the grade level of students testing. As part of the CDT training, students are told that the test is computer adaptive and designed to challenge them.

For CDT tests designed for students in grades 3 through 5, the response probability is set at 0.65. This response probability results in higher standard errors for the same number of items. However, there was concern that younger students may not have much experience with tests designed to be so challenging and could conceivably give up on a test that is perceived to be “too hard.”

ITEM POOL REFINEMENT

The CAT algorithm has configurable elements that allow for refinement of the item pool used in item selection. The two configurable elements are:

- **Restrict pool**—The ability to restrict the available item pool by grade/course at various points in the test.

  For example, Chemistry items are not available for the first 20 items of CDT Science Grades 6–HS test.

- **Favor items**—The ability to favor items that are close to the student's grade when evaluating items near a student's estimated score.

  For example, if a student is in grade 8 and the item selection routine finds appropriate items (in terms of difficulty) in grades 4, 5, 6, 7, and 8, item selection can favor items at or close to grade 8. It is possible that no items near a student's grade are appropriate in terms of difficulty. In such a case, the CAT algorithm will select items further away from the student's grade but appropriate based on item difficulty.

The difference between restricting the pool and favoring items is that when the pool is restricted, some items may NOT be selected. With favoring, all non-restricted items are eligible for administration, but they are made more or less LIKELY to be selected based on closeness to student grade.

PASSAGE RELATED CONCERNS

As previously mentioned, the CDT tests in the reading content area are passage-based. CDT passages have between one and seven associated items. The CAT algorithm does not require that all items associated with a passage be administered. Instead, it evaluates all possible combinations of items within a passage. Item sequencing within a passage is preserved when items are presented to the student. For example, if a six-item passage is selected and items 1 and 4 are NOT administered, then the items administered in order will be 2, 3, 5, and 6.

The configurable elements of passage-based CAT include:

- **Passage minimum percent**—Define the minimum percentage of the items associated with a passage to be used.

  For example, if the passage minimum percent is set at 80, then the selection routine will consider combinations such as 1 of 1 (100%), 4 of 5 (80%), 5 of 6 (83%), and 6 of 6 (100%). It will not consider combinations such as 1 of 2 (50%), 3 of 4 (75%), 3 of 5 (60%), etc. Near the end of a test, the passage minimum percent constraint may need to be loosened in order to meet content constraints such as number of items per diagnostic category.

- **Passage evaluation criteria**—Multiple factors are considered when evaluating and ranking each passage combination to determine the best combination to administer to a student. They include:
  - Percent of items associated with the passage used; the higher the percent, the higher the combination is ranked
  - Number of items associated with the passage used; the higher the number, the higher the combination is ranked
  - Distance between items' difficulties and student's estimated score; the smaller the distance, the higher the combination is ranked
  - Distance between the items' grade levels and the student's grade level; the smaller the distance, the higher the combination is ranked

  Different weights may be assigned to each of the factors. For example, if all of the weight is put on number of items used, then the algorithm will select the passages with the most associated items and administer all of them until the maximum number of items is reached.

TEST NAVIGATION

Many versions of computer adaptive tests do not allow students to skip items in the test or back up to previously answered items and change answers due to some complicating factors.

If students are allowed to skip items, the CAT algorithm would need to select additional items without any additional information (no change to Rasch ability estimates). Taken to the extreme, a student with no prior CDT scores who skipped every item starting with the first would receive an entire test of average items. It would not be adaptive at all.

If students are allowed to back up and change answers, Rasch ability estimates are re-calculated when answered are changed. This additional information can be used to select additional items but would not change previously selected items. For example, suppose a student is on item twenty-five and goes back to change the answer to item eleven from wrong to right. The total and corresponding diagnostic category Rasch ability estimates would go up. That additional information can be used in selection of items twenty-six and beyond. However, items twelve through twenty-five are not reselected even though different items may have been selected if item eleven was initially answered correctly. When it comes to items twelve through twenty-five, “the train has left the station.”

Also, if students are allowed to back up in the test, additional considerations must be put in place to ensure that the answer to one item does not cue another.

Currently all CDT tests except Reading Grades 3–5 and Reading/Lit Grades 6–HS do not allow skipping items or backing up and changing answers. On CDT tests in the reading content area, students are allowed to skip items within a passage. For example, when presented with a passage and five associated items, the student does not have to answer questions one through five in that order without skipping. If a student tries to navigate to the next passage without answering all of the items associated with a passage, the test engine will prompt the student to answer all items and will not move on to the next passage until all are answered.

TERMINATION

The CAT algorithm allows for both a fixed- or variable-length test.

With fixed length, the test ends when a student has taken a predefined number of items total and in each diagnostic category.

With variable length, the algorithm stops administering items from a diagnostic category when one of two conditions is satisfied:

- A student has taken at least a predefined minimum number of items in that diagnostic category and the standard error is below a predefined threshold

  OR

- A student has taken a predefined maximum number of items in that diagnostic category

The test ends when one of the two conditions above is satisfied for each of the diagnostic categories.

Note that with both fixed- and variable-length tests, there is no requirement that the predefined number of items in diagnostic categories be equal.

CAT CONFIGURATION – MATH GRADES 3–5

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 4 student will start with an item near the average difficulty of grade 4 items. Items are selected where the response probability is 0.65, meaning a student has a 65% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.62, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to restrict the pool and to favor items close to a student's grade. The pool restrictions are:

- no grade 7 items will be administered in the first 5 items,
- no grade 8 items will be administered in the first 10 items,
- no Algebra I items will be administered in the first 20 items, and
- no Geometry or Algebra II items will be administered.

Simulations were run with this configuration. On average:

- a total of 52 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.31, and
- standard errors for the diagnostic categories are in the range of 0.61 to 0.62.

DIAGNOSTIC CATEGORY TESTS

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Math Grades 3–5. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

CAT CONFIGURATION – MATH GRADES 6–HS

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 7 student will start with an item near the average difficulty of grade 7 items. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.60, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to restrict the pool and to favor items close to a student's grade. The pool restrictions are:

- no Algebra I items will be administered in the first 5 items,
- no Geometry items will be administered in the first 10 items, and
- no Algebra II items will be administered in the first 20 items.

Simulations were run with this configuration. On average:

- a total of 53 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.60 to 0.62.

DIAGNOSTIC CATEGORY TESTS

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Math Grades 6–HS. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

CAT CONFIGURATION – ALGEBRA I

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.60, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to restrict the pool and to favor items close to Algebra I. The pool restriction is that no Algebra II items will be administered in the first 16 items.

Simulations were run with this configuration. On average:

- a total of 53 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.31, and
- standard errors for the diagnostic categories are in the range of 0.61 to 0.63

DIAGNOSTIC CATEGORY TESTS

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Algebra I. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

CAT CONFIGURATION – GEOMETRY

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.60, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to favor items close to Geometry. There are no pool restrictions.

Simulations were run with this configuration. On average:

- a total of 53 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.60 to 0.61.

DIAGNOSTIC CATEGORY TESTS

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Geometry. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

CAT CONFIGURATION – ALGEBRA II

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.60, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to favor items close to Algebra II. There are no pool restrictions.

Simulations were run with this configuration. On average:

- a total of 53 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.60 to 0.71.

DIAGNOSTIC CATEGORY TESTS

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Algebra II. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

CAT CONFIGURATION – READING GRADES 3–5

The test has five diagnostic categories. Each student will take between 10 and 12 operational items per diagnostic category for a total test of 50 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 4 student will start with an item near the average difficulty of grade 4 items. Items are selected where the response probability is 0.65, meaning a student has a 65% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 10 operational items in that diagnostic category and the standard error is below 0.77, or
- a student has taken 12 operational items in that diagnostic category.

Functionality is used to run CAT with passages and favor items close to student's grade. The pool is restricted so that students will not receive passages associated with a grade that is more than four grades above the student's grade.

Passage minimum percent is set at 66%. That is, whenever possible, only passage combinations that use 66% or more of the associated items are used. (Near the end of a test, the passage minimum percent constraint may need to be loosened in order to meet content constraints.) Many simulations were run to arrive at this percent. On the one hand, testing time and reading load should be minimized. Therefore, students should not have to read long passages for only one or two items. On the other hand, using all items associated with a passage may not be desirable since some items are far from a student's estimated score. Given a limited number of items, those that are either too easy or too hard should not be used.

In evaluating and ranking passages, percent of items associated with the passage is not used. Simulation results indicate that if it is factored into evaluations, students take many short passages because 1 of 1 (100%) and 2 of 2 (100%) are ranked higher than 5 of 6 (83%) and 4 of 5 (80%), for example.

Simulations were run with this configuration. On average:

- a total of 56 operational items are administered—about 11 per diagnostic category,
- a total of 14 passages are administered,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.73 to 0.79.

DIAGNOSTIC CATEGORY TESTS

Diagnostic category tests in the reading content area are different than the other content areas because items are passage-based. Testing a single diagnostic category would result in students reading full passages for only one or two items. Instead, diagnostic category tests associated with Reading Grades 3-5 are separated by text type – literature text or informational text. Each of the two tests have three diagnostic categories[3]. Students take between 10 and 12 operational items per diagnostic category for a total test of 30 to 36 operational items. Diagnostic category tests were first available on January 28, 2019.

CAT CONFIGURATION – READING/LIT GRADES 6–HS

The test has five diagnostic categories. Each student will take between 10 and 12 operational items per diagnostic category for a total test of 50 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 7 student will start with an item near the average difficulty of grade 7 items. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 10 operational items in that diagnostic category and the standard error is below 0.75, or
- a student has taken 12 operational items in that diagnostic category.

Functionality is used to run CAT with passages and favor items close to student's grade. There are no pool restrictions.

Passage minimum percent is set at 66%. That is, whenever possible, only passage combinations that use 66% or more of the associated items are used. (Near the end of a test, the passage minimum percent constraint may need to be loosened in order to meet content constraints.) Many simulations were run to arrive at this percent. On the one hand, testing time and reading load should be minimized. Therefore, students should not have to read long passages for only one or two items. On the other hand, using all items associated with a passage may not be desirable since some items are far from a student's estimated score. Given a limited number of items, those that are either too easy or too hard should not be used.

In evaluating and ranking passages, percent of items associated with the passage is not used. Simulation results indicate that if it is factored into evaluations, students take many short passages because 1 of 1 (100%) and 2 of 2 (100%) are ranked higher than 5 of 6 (83%) and 4 of 5 (80%), for example.

[3] Key Ideas and Details, Craft and Structure/Integration of Knowledge and Ideas, Vocabulary

Simulations were run with this configuration. On average:

- a total of 56 operational items are administered—about 11 per diagnostic category,
- a total of 14 passages are administered,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.73 to 0.83.
- Note that the standard error is higher for in reading than the other content areas. This is because Reading Grades 3–5 and Reading/Lit Grades 6–HS are passage-based. Rather than selecting one targeted item at a time, the item selection routine evaluates and selects multiple items associated with a given passage. In general, items selected in this manner are not as close to the targeted response probability as stand-alone items selected one by one.

DIAGNOSTIC CATEGORY TESTS

Diagnostic category tests in the reading content area are different than the other content areas because items are passage-based. Testing a single diagnostic category would result in students reading full passages for only one or two items. Instead, diagnostic category tests associated with Reading/Literature Grades 6–HS are separated by text type – literature text or informational text. Each of the two tests have three diagnostic categories[4]. Students take between 10 and 12 operational items per diagnostic category for a total test of 30 to 36 operational items. Diagnostic category tests were first available on January 28, 2019.

CAT CONFIGURATION – SCIENCE GRADES 3–5

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 4 student will start with an item near the average difficulty of grade 4 items. Items are selected where the response probability is 0.65, meaning a student has a 65% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.62, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to restrict the pool and to favor items close to a student's grade. The pool restrictions are:

- no grade 11 items will be administered in the first 40 items, and
- no Biology or Chemistry items will be administered.

Simulations were run with this configuration. On average:

- a total of 52 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.31, and
- standard errors for the diagnostic categories are in the range of 0.62 to 0.63.

DIAGNOSTIC CATEGORY TESTS

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Science Grades 3–5. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

[4] Key Ideas and Details, Craft and Structure/Integration of Knowledge and Ideas, Vocabulary

CAT CONFIGURATION – SCIENCE GRADES 6–HS

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 7 student will start with an item near the average difficulty of grade 7 items. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.60, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to restrict the pool and to favor items close to a student's grade. The pool restrictions are:

- no grade 11 items will be administered in the first 20 items UNLESS the student is in grade 11 or 12,
- no Biology or Chemistry items will be administered in the first 20 items.

Simulations were run with this configuration. On average:

- a total of 53 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.61 to 0.64.

CATEGORY TESTS

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Science Grades 6–HS. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

CAT CONFIGURATION – BIOLOGY

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.60, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to favor items close to Biology. There are no pool restrictions.

Simulations were run with this configuration. On average:

- a total of 53 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.61 to 0.63.

DIAGNOSTIC CATEGORY TESTS

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Biology. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

CAT CONFIGURATION – CHEMISTRY

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.60, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to favor items close to Chemistry. There are no pool restrictions.

Simulations were run with this configuration. On average:

- a total of 53 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.60 to 0.65.

DIAGNOSTIC CATEGORY TESTS

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Chemistry. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

CAT CONFIGURATION – WRITING GRADES 3–5

The test has five diagnostic categories. Each student will take between 10 and 12 operational items per diagnostic category for a total test of 50 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 4 student will start with an item near the average difficulty of grade 4 items. Items are selected where the response probability is 0.65, meaning a student has a 65% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 10 operational items in that diagnostic category and the standard error is below 0.67, or
- a student has taken 12 operational items in that diagnostic category.

Functionality is used to favor items close to the student’s grade. There are no pool restrictions.

Simulations were run with this configuration. On average:

- a total of 55 operational items are administered—about 11 per diagnostic category,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.68 to 0.70.

DIAGNOSTIC CATEGORY TESTS

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the five diagnostic categories associated with Writing Grades 3–5. Given that the content is limited to a single diagnostic category, the number of items is increased from 10 to 12 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

CAT CONFIGURATION – WRITING/ENG COMP GRADES 6–HS

The test has five diagnostic categories. Each student will take between 10 and 12 operational items per diagnostic category for a total test of 50 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 7 student will start with an item near the average difficulty of grade 7 items. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 10 operational items in that diagnostic category and the standard error is below 0.65, or
- a student has taken 12 operational items in that diagnostic category.

Functionality is used to favor items close to the student's grade. There are no pool restrictions.

Simulations were run with this configuration. On average:

- a total of 56 operational items are administered—about 11 per diagnostic category,
- standard error for the total score is 0.29, and
- standard errors for the diagnostic categories are in the range of 0.67 to 0.71.

DIAGNOSTIC CATEGORY TESTS

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the five diagnostic categories associated with Writing/English Composition Grades 6–HS. Given that the content is limited to a single diagnostic category, the number of items is increased from 10 to 12 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

Tables 13–7 through 13–12 summarize CAT configurations by content area.

Table 13–7. CAT Configuration Summary – Mathematics

	Math Grades 3–5	Math Grades 6–HS
Number of DCs	4	4
Number of OP Items per DC	12–15	12–15
Number of OP Items Total	48–60	48–60
Number of FT Items Total	0	0
Entry Point: No Prior CDT	average item by grade	average item by grade
Entry Point: Prior CDT	prior diagnostic scores	prior diagnostic scores
Item Selection: Rasch Ability Estimates	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate
Item Selection: Response Probability	0.65	0.50
Item Selection: Favor Items	close to student grade	close to student grade
Item Selection: Pool Restriction	Items 1–5: no Grade 7	Items 1–5: no Algebra I
Item Selection: Pool Restriction	Items 1–10: no Grade 8	Items 1–10: no Geometry
Item Selection: Pool Restriction	Items 1–20: no Algebra I	Items 1–20: no Algebra II
Item Selection: Pool Restriction	No Geometry	
Item Selection: Pool Restriction	No Algebra II	
Navigation	no skip; no backtrack	no skip; no backtrack
Termination	12 items per DC, SE < 0.62 OR 15 items per DC	12 items per DC, SE < 0.60 OR 15 items per DC

DC = Diagnostic Category

Table 13–8. CAT Configuration Summary – Algebra I, Geometry, and Algebra II

	Algebra I	Geometry	Algebra II
Number of DCs	4	4	4
Number of OP Items per DC	12–15	12–15	12–15
Number of OP Items Total	48–60	48–60	48–60
Number of FT Items Total	0	0	0
Entry Point: No Prior CDT	average item	average item	average item
Entry Point: Prior CDT	prior diagnostic scores	prior diagnostic scores	prior diagnostic scores
Item Selection: Rasch Ability Estimates	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate
Item Selection: Response Probability	0.50	0.50	0.50
Item Selection: Favor Items	close to Algebra I	close to Geometry	close to Algebra II
Item Selection: Pool Restriction	Items 1–16: no Algebra II	None	None
Navigation	no skip; no backtrack	no skip; no backtrack	no skip; no backtrack
Termination	12 items per DC, SE < 0.60 OR 15 items per DC	12 items per DC, SE < 0.60 OR 15 items per DC	12 items per DC, SE < 0.60 OR 15 items per DC

DC = Diagnostic Category

Table 13–9. CAT Configuration Summary – Reading

	Reading Grades 3–5	Reading/Lit Grades 6–HS
Number of DCs	5	5
Number of OP Items per DC	10–12	10–12
Number of OP Items Total	50–60	50–60
Number of FT Items Total	0	0
Entry Point: No Prior CDT	average item by grade	average item by grade
Entry Point: Prior CDT	prior diagnostic scores	prior diagnostic scores
Item Selection: Rasch Ability Estimates	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate
Item Selection: Response Probability	0.65	0.50
Item Selection: Favor Items	close to student grade	close to student grade
Item Selection: Pool Restriction	No items from grades more than four above student grade	None
Passage Min %	66	66
Navigation	skip items within passage	skip items within passage
Termination	10 items per DC, SE < 0.77 OR 12 items per DC	10 items per DC, SE < 0.75 OR 12 items per DC

DC = Diagnostic Category

Table 13–10. CAT Configuration Summary – Science

	Science Grades 3–5	Science Grades 6–HS
Number of DCs	4	4
Number of OP Items per DC	12–15	12–15
Number of OP Items Total	48–60	48–60
Number of FT Items Total	0	0
Entry Point: No Prior CDT	average item by grade	average item by grade
Entry Point: Prior CDT	prior diagnostic scores	prior diagnostic scores
Item Selection: Rasch Ability Estimates	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate
Item Selection: Response Probability	0.65	0.50
Item Selection: Favor Items	close to student grade	close to student grade
Item Selection: Pool Restriction	Items 1–40: no grade 11	Students in grades 6–10 Items 1–20: no grade 11, Biology, or Chemistry
Item Selection: Pool Restriction	No Biology	Students in grades 11–12 Items 1–20: no Biology, or Chemistry
Item Selection: Pool Restriction	No Chemistry	
Navigation	no skip; no backtrack	no skip; no backtrack
Termination	12 items per DC, SE < 0.62 OR 15 items per DC	12 items per DC, SE < 0.60 OR 15 items per DC

DC = Diagnostic Category

Table 13–11. CAT Configuration Summary – Biology and Chemistry

	Biology	Chemistry
Number of DCs	4	4
Number of OP Items per DC	12–15	12–15
Number of OP Items Total	48–60	48–60
Number of FT Items Total	0	0
Entry Point: No Prior CDT	average item	average item
Entry Point: Prior CDT	prior diagnostic scores	prior diagnostic scores
Item Selection: Rasch Ability Estimates	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate
Item Selection: Response Probability	0.50	0.50
Item Selection: Favor Items	close to Biology	close to Chemistry
Item Selection: Pool Restriction	None	None
Navigation	no skip; no backtrack	no skip; no backtrack
Termination	12 items per DC, SE < 0.60 OR 15 items per DC	12 items per DC, SE < 0.60 OR 15 items per DC

DC = Diagnostic Category

Table 13–12. CAT Configuration Summary – Writing

	Writing Grades 3–5	Writing/Eng Comp Gr 6–HS
Number of DCs	5	5
Number of OP Items per DC	10–12	10–12
Number of OP Items Total	50–60	50–60
Number of FT Items Total	0	0
Entry Point: No Prior CDT	average item by grade	average item by grade
Entry Point: Prior CDT	prior diagnostic scores	prior diagnostic scores
Item Selection: Rasch Ability Estimates	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate
Item Selection: Response Probability	0.65	0.50
Item Selection: Favor Items	close to student grade	close to student grade
Item Selection: Pool Restriction	None	None
Navigation	no skip; no backtrack	no skip; no backtrack
Termination	10 items per DC, SE < 0.67 OR 12 items per DC	10 items per DC, SE < 0.65 OR 12 items per DC

DC = Diagnostic Category

CHAPTER FOURTEEN: SCORES AND SCORE REPORTS

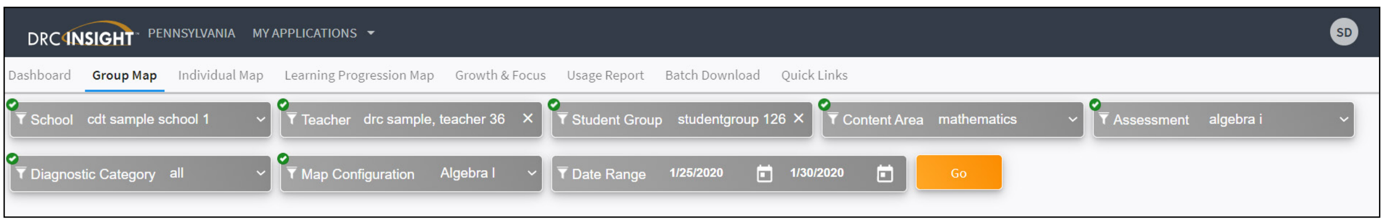
Teachers will receive immediate and usable data to be used for targeting instruction to meet the needs of individual students. The CDT Interactive Reports provide direct links to resources in SAS, including specific lesson plans, interventions, and other resources. The reports can also show the progress of students across test administrations. This overview summarizes the steps in accessing the interactive reports, as well as the types of information available for each type of report.

ACCESSING INTERACTIVE REPORTS

Any user with the role of District, School, or Teacher has the ability to view CDT Interactive Reports accessed through the DRC INSIGHT Portal. Once the user is logged in, Report Delivery can be selected under MY APPLICATIONS, at the top of the screen. Next, the user selects CDT Interactive Reports. The user is presented general information on the Dashboard with separate tabs for each report. Once a report is selected, the user will begin to make selections within the available pre-filters to generate the report to be displayed.

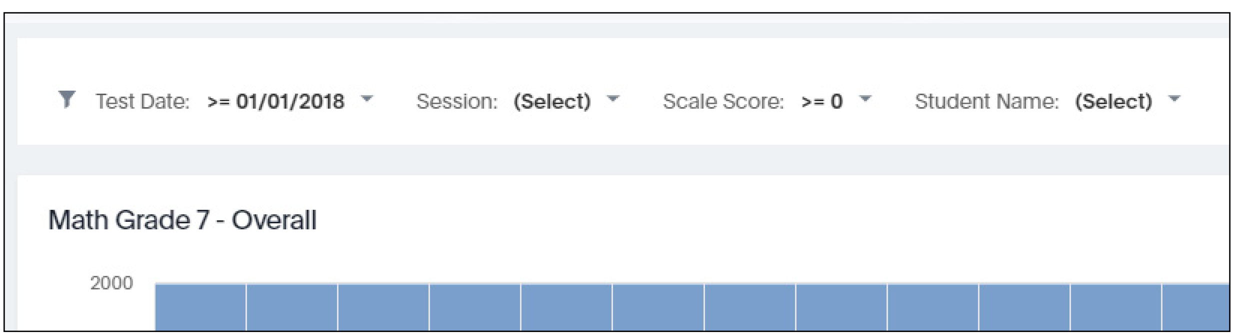
The pre-filters include: District, School, Teacher, Student Group, Content Area, Assessment, Diagnostic Category, Map Configuration, Date Range. The filters are smart filters. This means the filter will pre-populate based on the data the user has access to or based on the previous filter selections made.

Figure 14–1. Pre-Filter Screen



A secondary set of filters is available within each report to further refine the data reported on the page. Each reporting table and map has its own filters and selections to sort the data in a way that maximizes the ability for teachers to evaluate performance for a group or sub-set of students. The secondary filters enable teachers to view a subset of the data displayed. In the example below, filters include test date, test session selection(s), scale score range, and student name selection(s).

Figure 14–2. Secondary-Filter Screen

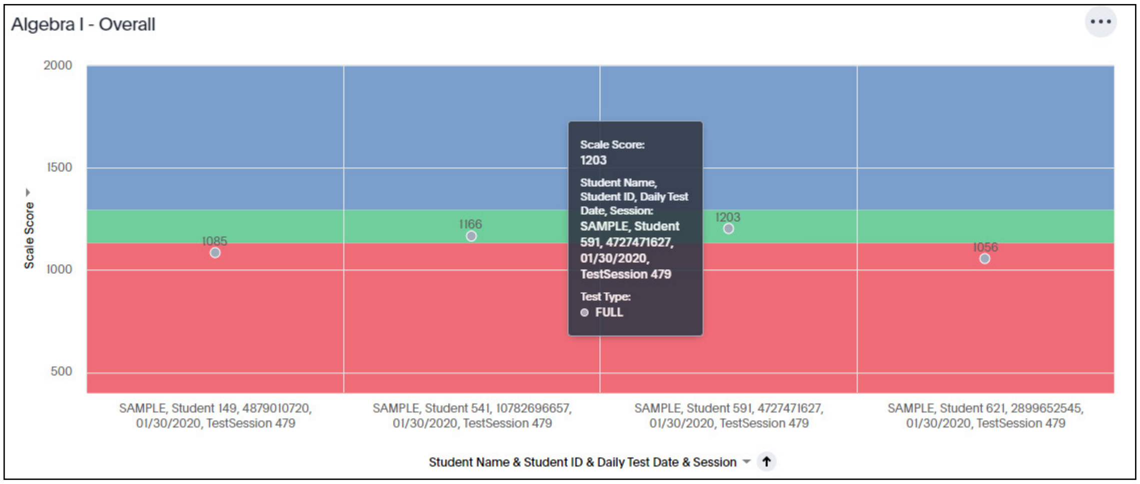


There are four types of interactive reports for the CDT: Group Map, Individual Map, Learning Progression Map, and Growth and Focus Map.

GROUP MAP

The group-level reports provide teachers insightful information and data about classroom performance, including students' strengths to build on and areas of need. The group maps allow users to view overall classroom performance on a given assessment; to view eligible content associated with student scores; and to sort the data in various ways to make smaller student groups for targeted instruction. The group map is made up of several different data displays, which are discussed below.

Figure 14–3. Sample Overall Group Map



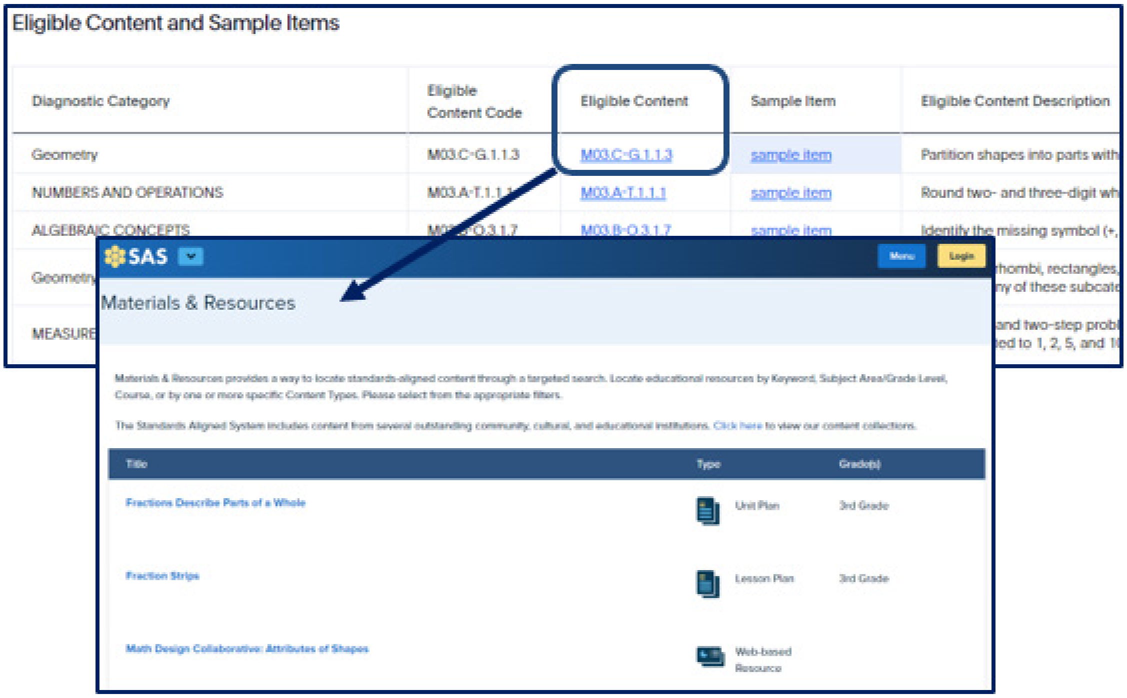
The Interactive Reports use colors to indicate relative **Strengths to Build On** and **Areas of Need**. Each descriptor correlates with a color range on the scale: Green/Blue = Strengths to Build On; Red = Areas of Need.

- Each gray dot on the Group Map represents a single student score.
- Additional information displays when the user hovers over the dot: student name, test date, and score.
- Only students within the Student Group with scores will have a gray dot appear on the map.
- All dots represent the assessment score(s) during the administration window, identified using the Date Range filter.
- The Group Map is intended to provide general assessment information based on a group of student scores within a full CDT assessment and/or Diagnostic Category CDT.
- The Diagnostic Category maps, found below the Group Map, provide all scores associated with the Diagnostic Categories tested within the full assessment, as well as for all individual Diagnostic Category CDT assessments completed. The scores are represented with yellow plotted dots.
- The data is also displayed in a grid that provides a complete list of the students within the selected student group with accompanying score information. The data from the grid can be exported as a CSV file.

Initially, the Group Map shows the entire vertical scale (representing scores from 200 to 2000 for Lower Grades Mathematics, Lower Grades Reading, Lower Grades Science, and Lower Grades Writing; representing scores from 400 to 2000 for Mathematics, Algebra I, Algebra II, Geometry, Reading/Literature, Science, Biology, Chemistry, and Writing/English Composition). The **Scale Score** filter provides the user the ability to narrow the reported set of students down to those falling in similar ranges.

If a user chooses one diagnostic category from the prefilters then additional detail is displayed at an eligible content level, including a description of the eligible content, links to a sample item, and links to instructional resources found on the SAS website.

Figure 14–4. Eligible Content and Sample Items

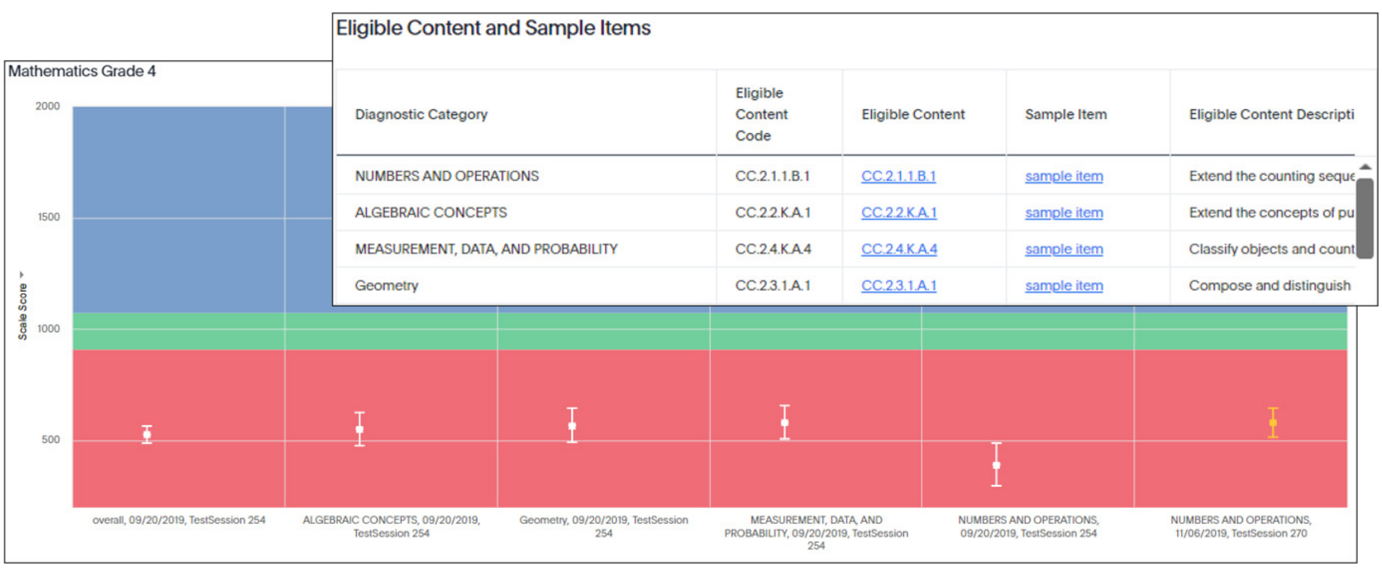


INDIVIDUAL MAP

The CDT Individual Map shows how an individual student performed on a given assessment, with scores plotted on the CDT scale. The columns in the Individual Map represent the individual tests taken by the student. In adherence reporting guidelines outlined in the *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 2014), a standard error band is displayed for each score. This interval represents the range where the student would likely score if tested again without additional instruction. The use of error bands supports more-accurate interpretation of scores (i.e., not over-interpreting scores) since error bands that overlap indicate that scores are not significantly different.

Similar to the Group Map, the Individual Map provides Eligible Content and Sample Items at the student level. This display contains sample items, eligible content descriptions, and links to materials and resources on SAS.

Figure 14–5. Sample Individual Map and Eligible Content Associated with a Student's Score



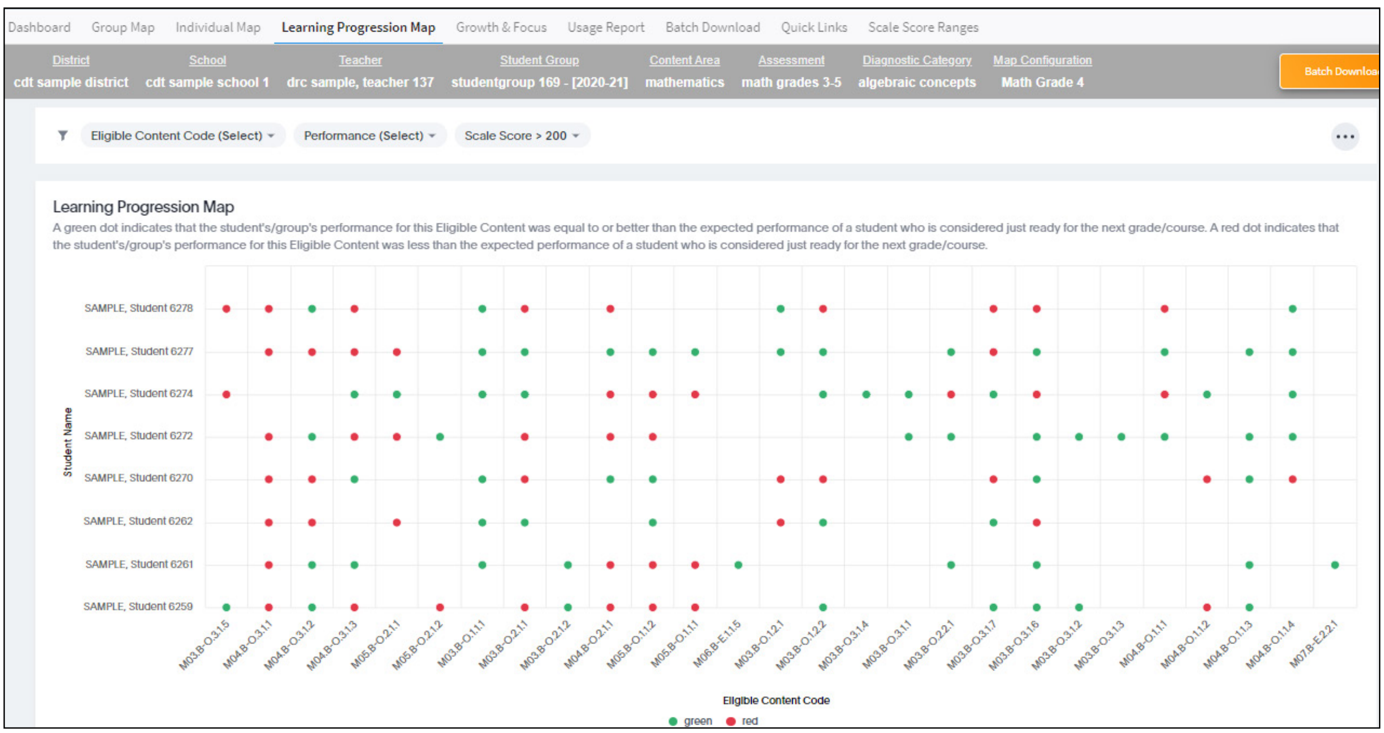
The Individual Map has the ability to show the all assessments that apply to the preliminary filter selections for an individual student. The Individual Map is intended to provide general Instructional Enrichment (a set of Eligible Content) based on a student's score within a Diagnostic Category. Additional data displays on the Individual Map include hover overs and a grid view.

GROUP AND INDIVIDUAL LEARNING PROGRESSION MAP

The Group and Individual Learning Progression Map is a graphical representation about how learning may typically move toward increased understanding over time based on Eligible Content. Each column represents the Eligible Content in a subject's domain and subdomain and for a specific grade level or course. Each row represents student performance on the eligible content.

- A ***green*** dot indicates that the student was presented with at least one test item for the Eligible Content and performed as well or better than the expected performance of a student who is considered just ready for the next grade/course.
- A ***red*** dot indicates that the student was presented with at least one test item from the Eligible Content and the student's performance was less than the expected performance of a student who is considered just ready for the next grade/course.
- An empty box represents Eligible Content that is available, but the student was not presented with any test items from that Eligible Content.

Figure 14–6. Sample Learning Progression Map



Additional data displays within the Learning Progression map include a summary by eligible content code, a grade-level summary, and information in a grid format.

GROWTH AND FOCUS REPORT

The Growth and Focus report is designed to aid teachers in goal-setting with students by identifying students that fall in the “all” group or a “focus” group.

Students within the “all” group have an overall score higher or equal to the score at the bottom of the green area of the Group Map for the previous grade level. Students within the “focus” group are students who have an overall score that is less than the bottom of green of the previous grade level. These are students who could benefit from individual or small-group interventions.

The table is designed to allow educators to view one test event or compare two test events to determine if a student had significant growth between test sessions. The calculations that generate this report use the standard error information found in the Individual Maps to determine if there was significant growth.

Figure 14–7. Growth and Focus Report

Growth & Focus - Math Grade 4

Student Name ↑	Test Session 1	Scale Score 1	Test Session 2	Scale Score 2	Change in Score	SEM	Significant Growth	Group
SAMPLE, Student 6259	TestSession 192	773	TestSession 489	1022	249	72	yes	all
SAMPLE, Student 6261	TestSession 192	940	TestSession 489	1115	175	74	yes	all
SAMPLE, Student 6270	TestSession 192	762	TestSession 489	709	-53	72	no	focus
SAMPLE, Student 6272	TestSession 192	985	TestSession 489	1063	78	81	no	all
SAMPLE, Student 6274	TestSession 192	772	TestSession 489	813	41	77	no	focus
SAMPLE, Student 6277	TestSession 192	967	TestSession 489	885	-82	76	no	all
SAMPLE, Student 6278	TestSession 192	583	TestSession 489	756	173	74	yes	focus

OTHER CDT REPORTING COMPONENTS

STUDENT CONFERENCING REPORT: Data gives educators a comprehensive student-level report that compares recent test events for the same content area tested. This can include full CDT events, as well as individual Diagnostic Category CDT results. Teachers frequently use this report during one-on-one conferences with students and during conversations with parents because it provides a clear picture of student performance that can be easily printed or distributed via email.

DISTRICT STUDENT DATA FILE: District-level data is easily accessible using the District Data File download feature. This file is updated nightly and can be downloaded at any time throughout the CDT testing window. It includes student-level data for all schools within the district that have completed test events.

USAGE REPORT: DRC provides CDT usage reports in a variety of user-friendly formats (pie charts, bar graphs, CSV export files) that will allow administrators at SDP to easily view a summary of CDT usage by school. Users can filter the report content to best match their intended use.

CHAPTER FIFTEEN: OPERATIONAL ADMINISTRATION 2021–2022

This chapter contains summary information about the operational administration of the Classroom Diagnostic Tools (CDT) during the 2021–2022 school year. Two types of CDTs were available—full CDTs and diagnostic category CDTs. Full CDTs test four or five diagnostic categories in one test session. Diagnostic category CDTs focus on a single diagnostic category in math, science and writing, or a single text type with three diagnostic categories in reading. Results in this chapter focus on full CDTs except where specifically noted.

FREQUENCIES

Tables 15–1 through 15–3 present information related to the number of students who were administered one or more CDT tests in the 2021–2022 school year. Tables 15–1a and 15–1b show the number of students who have taken each CDT. Some of these students have taken the same CDT test multiple times or have taken multiple CDT tests. Tables 15–1a and 15–1b count only the first administration of each CDT test. Data about multiple administrations of the same test and multiple CDT tests are presented in Tables 15–2 and 15–3, respectively.

Table 15–1a. Number of Students Taking the First Administration of a Full CDT by Grade Level

CDT	3	4	5	6	7	8	9	10	11	12	TOTAL
Math Grades 3–5	15,352	16,447	19,792	-	-	-	-	-	-	-	51,591
Math Grades 6–HS	-	-	-	23,607	26,825	23,649	339	50	27	15	74,512
Algebra I	-	-	-	102	992	5,355	23,915	8,867	2,741	545	42,517
Geometry	-	-	-	2	36	125	1,226	1,668	1,173	149	4,379
Algebra II	-	-	-	1	8	125	982	1,928	1,068	314	4,426
Reading Grades 3–5	14,296	16,041	18,151	-	-	-	-	-	-	-	48,488
Reading/Lit Grades 6–HS	-	-	-	19,134	21,803	21,539	20,096	30,990	5,734	1,219	120,515
Science Grades 3–5	2,017	9,635	3,796	-	-	-	-	-	-	-	15,448
Science Grades 6–HS	-	-	-	9,461	15,034	24,330	971	178	99	46	50,119
Biology	-	-	-	0	17	118	21,492	22,268	3,644	566	48,105
Chemistry	-	-	-	0	0	4	710	1,139	986	142	2,981
Writing Grades 3–5	1,922	2,365	3,096	-	-	-	-	-	-	-	7,383
Writing/Eng Comp Grades 6–HS				4,449	6,271	6,320	1,216	1,896	810	259	21,221

Table 15–1b. Number of Students Taking the First Administration of a Diagnostic Category CDT by Grade Level

CDT	Diagnostic Category	3	4	5	6	7	8	9	10	11	12	TOTAL
Math Grades 3–5	Numbers and Operations	4,735	4,798	6,600	-	-	-	-	-	-	-	16,133
Math Grades 3–5	Algebraic Concepts	2,326	2,444	1,776	-	-	-	-	-	-	-	6,546
Math Grades 3–5	Geometry	896	715	801	-	-	-	-	-	-	-	2,412
Math Grades 3–5	Measurement, Data, and Probability	902	731	789	-	-	-	-	-	-	-	2,422
Math Grades 6–HS	Numbers and Operations	-	-	-	6,057	5,314	4,407	71	26	10	9	15,894
Math Grades 6–HS	Algebraic Concepts	-	-	-	4,676	6,085	4,811	33	11	4	1	15,621
Math Grades 6–HS	Geometry	-	-	-	1,551	1,882	1,875	0	0	0	0	5,308
Math Grades 6–HS	Measurement, Data, and Probability	-	-	-	1,143	1,317	1,235	0	0	0	0	3,695
Algebra I	Operations with Real Numbers and Expressions	-	-	-	0	13	427	2,783	872	215	58	4,368
Algebra I	Linear Equations & Inequalities	-	-	-	38	202	882	3,832	1,151	331	81	6,517
Algebra I	Functions & Coordinate Geometry	-	-	-	0	7	273	2,859	803	246	41	4,229
Algebra I	Data Analysis	-	-	-	0	6	188	1,660	498	180	50	2,582
Geometry	Geometric Properties	-	-	-	0	0	0	11	53	8	2	74
Geometry	Congruence, Similarity, and Proofs	-	-	-	0	0	0	11	49	7	2	69
Geometry	Coordinate Geometry and Right Triangles	-	-	-	0	0	0	12	83	38	11	144
Geometry	Measurement	-	-	-	0	0	2	90	86	30	12	220
Algebra II	Operations with Complex Numbers	-	-	-	0	0	73	172	87	15	18	365
Algebra II	Non-Linear Expressions & Equations	-	-	-	0	0	51	81	57	8	6	203

Table 15–1b (continued). Number of Students Taking the First Administration of a Diagnostic Category CDT by Grade Level

CDT	Diagnostic Category	3	4	5	6	7	8	9	10	11	12	TOTAL
Algebra II	Functions	-	-	-	0	0	50	55	78	56	24	263
Algebra II	Data Analysis	-	-	-	0	0	47	0	5	20	21	93
Reading Grades 3–5	Informational Text	2,255	1,995	3,310	-	-	-	-	-	-	-	7,560
Reading Grades 3–5	Literature Text	2,277	2,675	2,141	-	-	-	-	-	-	-	7,093
Reading/Lit Grades 6–HS	Informational Text	-	-	-	4,424	4,481	3,898	3,859	4,655	411	213	21,941
Reading/Lit Grades 6–HS	Literature Text	-	-	-	3,041	3,696	3,727	3,655	4,589	440	153	19,301
Science Grades 3–5	The Nature of Science	2	925	666	-	-	-	-	-	-	-	1,593
Science Grades 3–5	Biological Sciences	38	708	125	-	-	-	-	-	-	-	871
Science Grades 3–5	Physical Sciences	2	738	300	-	-	-	-	-	-	-	1,040
Science Grades 3–5	Earth and Space Sciences	2	618	36	-	-	-	-	-	-	-	656
Science Grades 6–HS	The Nature of Science	-	-	-	2,672	5,547	6,122	199	16	15	17	14,588
Science Grades 6–HS	Biological Sciences	-	-	-	717	4,604	1,307	98	53	14	15	6,808
Science Grades 6–HS	Physical Sciences	-	-	-	420	1,054	3,372	344	22	81	37	5,330
Science Grades 6–HS	Earth and Space Sciences	-	-	-	1,203	1,696	1,231	24	37	97	86	4,374
Biology	Basic Biological Principles/ Chemical Basis for Life	-	-	-	0	0	4	5,058	4,531	920	65	10,578
Biology	Bioenergetics/ Homeostasis and Transport	-	-	-	0	0	2	2,847	3,606	487	55	6,997
Biology	Cell Growth and Reproduction/ Genetics	-	-	-	0	0	3	1,403	2,028	309	35	3,778
Biology	Theory of Evolution/Ecology	-	-	-	0	0	28	2,323	1,363	80	20	3,814

Table 15–1b (continued). Number of Students Taking the First Administration of a Diagnostic Category CDT by Grade Level

CDT	Diagnostic Category	3	4	5	6	7	8	9	10	11	12	TOTAL
Chemistry	Properties and Classification of Matter	-	-	-	0	0	0	0	73	74	3	150
Chemistry	Atomic Structure and The Periodic Table	-	-	-	0	0	0	90	260	136	8	494
Chemistry	The Mole and Chemical Bonding	-	-	-	0	0	0	0	8	25	2	35
Chemistry	Chemical Relationships and Reactions	-	-	-	0	0	0	0	9	26	2	37
Writing Grades 3–5	Quality of Writing: Focus and Organization	52	93	173	-	-	-	-	-	-	-	318
Writing Grades 3–5	Quality of Writing: Content and Style	39	71	38	-	-	-	-	-	-	-	148
Writing Grades 3–5	Quality of Writing: Editing	0	36	71	-	-	-	-	-	-	-	107
Writing Grades 3–5	Conventions: Punctuation, Capitalization, and Spelling	621	633	636	-	-	-	-	-	-	-	1,890
Writing Grades 3–5	Conventions: Grammar and Sentence Formation	585	688	1,024	-	-	-	-	-	-	-	2,297
Writing/Eng Comp Grades 6–HS	Quality of Writing: Focus and Organization	-	-	-	359	317	500	61	93	16	6	1,352
Writing/Eng Comp Grades 6–HS	Quality of Writing: Content and Style	-	-	-	59	241	448	56	27	20	12	863
Writing/Eng Comp Grades 6–HS	Quality of Writing: Editing	-	-	-	42	49	163	60	46	14	7	381
Writing/Eng Comp Grades 6–HS	Conventions: Punctuation, Capitalization, and Spelling	-	-	-	1,060	1,198	1,080	166	204	80	24	3,812
Writing/Eng Comp Grades 6–HS	Conventions: Grammar and Sentence Formation	-	-	-	1,057	1,528	1,374	177	263	109	29	4,537

Table 15–2a. Multiple Administrations of the Same Full CDT Test

CDT	Students with 1 Administration	Students with 2 Administrations	Students with 3 Administrations	Students with 4 Administrations	Students with 5 Administrations
Math Grades 3–5	51,591	38,911	16,288	180	5
Math Grades 6–HS	74,512	52,572	19,906	1,180	21
Algebra I	42,517	25,340	8,703	396	2
Geometry	4,379	3,074	1,090	52	0
Algebra II	4,426	2,953	920	0	0
Reading Grades 3–5	48,488	36,988	14,918	71	1
Reading/Lit Grades 6–HS	120,515	80,112	23,384	1,669	117
Science Grades 3–5	15,448	11,046	4,518	10	1
Science Grades 6–HS	50,119	32,295	11,385	959	1
Biology	48,105	29,410	9,528	438	4
Chemistry	2,981	2,287	996	37	1
Writing Grades 3–5	7,383	5,086	1,224	2	0
Writing/Eng Comp Gr 6–HS	21,221	13,305	3,967	6	0

Table 15–2b. Multiple Administrations of the Same Diagnostic Category CDT Test

CDT	Diagnostic Category	Students with 1 Administration	Students with 2 Administrations	Students with 3 Administrations	Students with 4 Administrations	Students with 5 Administrations
Math Grades 3–5	Numbers and Operations	16,133	9,071	3,142	297	5
Math Grades 3–5	Algebraic Concepts	6,546	2,212	481	0	0
Math Grades 3–5	Geometry	2,412	637	5	0	0
Math Grades 3–5	Measurement, Data, and Probability	2,422	1,065	20	0	0
Math Grades 6–HS	Numbers and Operations	15,894	8,041	1,952	108	0
Math Grades 6–HS	Algebraic Concepts	15,621	5,863	747	78	0
Math Grades 6–HS	Geometry	5,308	1,179	45	0	0
Math Grades 6–HS	Measurement, Data, and Probability	3,695	626	2	0	0
Algebra I	Operations with Real Numbers and Expressions	4,368	1,050	129	0	0
Algebra I	Linear Equations & Inequalities	6,517	1,810	315	1	0
Algebra I	Functions & Coordinate Geometry	4,229	930	176	1	0
Algebra I	Data Analysis	2,582	415	2	0	0
Geometry	Geometric Properties	74	54	0	0	0
Geometry	Congruence, Similarity, and Proofs	69	54	0	0	0
Geometry	Coordinate Geometry and Right Triangles	144	110	1	0	0
Geometry	Measurement	220	121	0	0	0
Algebra II	Operations with Complex Numbers	365	218	0	0	0
Algebra II	Non-Linear Expressions & Equations	203	122	0	0	0
Algebra II	Functions	263	94	0	0	0
Algebra II	Data Analysis	93	78	0	0	0
Reading Grades 3–5	Informational Text	7,560	3,413	1,357	131	21
Reading Grades 3–5	Literature Text	7,093	4,468	2,687	193	0

Table 15–2b (continued). Multiple Administrations of the Same Diagnostic Category CDT Test

CDT	Diagnostic Category	Students with 1 Administration	Students with 2 Administrations	Students with 3 Administrations	Students with 4 Administrations	Students with 5 Administrations
Reading/Lit Grades 6–HS	Informational Text	21,941	8,088	1,362	130	1
Reading/Lit Grades 6–HS	Literature Text	19,301	8,751	1,372	21	0
Science Grades 3–5	The Nature of Science	1,593	922	434	0	0
Science Grades 3–5	Biological Sciences	871	520	263	0	0
Science Grades 3–5	Physical Sciences	1,040	553	239	0	0
Science Grades 3–5	Earth and Space Sciences	656	508	272	0	0
Science Grades 6–HS	The Nature of Science	14,588	7,397	1,972	79	0
Science Grades 6–HS	Biological Sciences	6,808	3,219	1,129	0	0
Science Grades 6–HS	Physical Sciences	5,330	2,384	1,198	1	0
Science Grades 6–HS	Earth and Space Sciences	4,374	2,417	970	0	0
Biology	Basic Biological Principles/ Chemical Basis for Life	10,578	1,406	184	0	0
Biology	Bioenergetics/ Homeostasis and Transport	6,997	417	76	0	0
Biology	Cell Growth and Reproduction/ Genetics	3,778	212	33	0	0
Biology	Theory of Evolution/Ecology	3,814	822	51	14	0
Chemistry	Properties and Classification of Matter	150	14	0	0	0
Chemistry	Atomic Structure and The Periodic Table	494	246	32	0	0
Chemistry	The Mole and Chemical Bonding	35	13	0	0	0
Chemistry	Chemical Relationships and Reactions	37	14	0	0	0
Writing Grades 3–5	Quality of Writing: Focus and Organization	318	196	160	132	0

Table 15–2b (continued). Multiple Administrations of the Same Diagnostic Category CDT Test

CDT	Diagnostic Category	Students with 1 Administration	Students with 2 Administrations	Students with 3 Administrations	Students with 4 Administrations	Students with 5 Administrations
Writing Grades 3–5	Quality of Writing: Content and Style	148	0	0	0	0
Writing Grades 3–5	Quality of Writing: Editing	107	0	0	0	0
Writing Grades 3–5	Conventions: Punctuation, Capitalization, and Spelling	1,890	1,320	861	0	0
Writing Grades 3–5	Conventions: Grammar and Sentence Formation	2,297	1,568	869	0	0
Writing/Eng Comp Gr 6–HS	Quality of Writing: Focus and Organization	1,352	397	215	42	0
Writing/Eng Comp Gr 6–HS	Quality of Writing: Content and Style	863	97	0	0	0
Writing/Eng Comp Gr 6–HS	Quality of Writing: Editing	381	100	0	0	0
Writing/Eng Comp Gr 6–HS	Conventions: Punctuation, Capitalization, and Spelling	3,812	1,747	812	71	1
Writing/Eng Comp Gr 6–HS	Conventions: Grammar and Sentence Formation	4,537	1,899	901	59	0

Table 15–3a. Number of Students in Grades 3 through 5 Taking Multiple Full CDT Tests

Grades 3 through 5	Math	Reading	Science	Writing
Math Grades 3–5	-	-	-	-
Reading Grades 3–5	43,341	-	-	-
Science Grades 3–5	8,318	8,107	-	-
Writing Grades 3–5	5,668	4,977	2,380	-

Table 15–3b. Number of Students in Grades 6 and above Taking Multiple Full CDT Tests

Grades 6 and above	Math	Algebra I	Geometry	Algebra II	Reading/ Literature	Science	Biology	Chemistry	Writing/ English Comp.
Math Grades 6–HS	-	-	-	-	-	-	-	-	-
Algebra I	1,993	-	-	-	-	-	-	-	-
Geometry	52	118	-	-	-	-	-	-	-
Algebra II	4	171	195	-	-	-	-	-	-
Reading/Lit Grades 6–HS	52,840	21,300	2,241	2,558	-	-	-	-	-
Science Grades 6–HS	28,796	3,865	70	115	27,707	-	-	-	-
Biology	112	13,669	1,250	1,463	23,792	197	-	-	-
Chemistry	8	106	865	382	1,036	0	79	-	-
Writing/Eng Comp Grades 6–HS	13,332	2,772	582	788	16,240	8,903	1,772	404	-

Further demographic information about students tested with the CDT is found in the next section.

DEMOGRAPHIC CHARACTERISTICS

COMPOSITION OF SAMPLE USED IN SUBSEQUENT TABLES

To avoid double counting of students, the following demographic tables are based on students' first administration for a given CDT test. Students taking only diagnostic category tests are counted with the parent test[1]. For example, a student taking Math Grades 3–5 Numbers and Operations is counted under Math Grades 3–5. Students who took the same test multiple times are counted only once. Students who took different tests are counted for each test. For example, if a student took CDT Algebra I twice, he or she is counted only once in the Algebra I counts; if a student took Algebra I once and Biology once, he or she is counted in both Algebra I and Biology counts.

COLLECTION OF STUDENT DEMOGRAPHIC INFORMATION

Data for analyses of demographic characteristics were obtained primarily from information supplied by school district personnel through the Pennsylvania Information Management System (PIMS) and subsequently transmitted to DRC. However, teachers may assign CDT tests to students who do not have data in PIMS at the time of testing. This may result in CDT records with incomplete demographic information.

DEMOGRAPHIC CHARACTERISTICS

Frequency data for various demographic categories are presented in Tables 15–4 through 15–16. Shown at the bottom of the appropriate table is the number of students with a total test score on which the column percentages are based. Percentages in some categories may sum to a quantity below 100 percent due to missing data.

Analyses are broken out by grade level. However, in the case of course-specific CDT tests (Algebra I, Geometry, Algebra II, Biology, and Chemistry), students across multiple grades may be enrolled in the course.

Caution should be used in interpreting CDT demographic data, since participation is voluntary and complete demographic data via PIMS is not required for testing. This is especially true for rows in the lower half of the tables (e.g., IEP, Migrant, and Economically Disadvantaged) because these typically have more than ninety-five percent blank responses.

[1] Approximately 11% of students take only diagnostic category tests.

Table 15–4. Demographic Characteristics of Students Taking CDT Math Grades 3–5

Demographic or Educational Characteristic	Gr. 3	Gr. 4	Gr. 5	Total
Female (N)	9,302	9,782	11,380	30,464
Female (Pct)	49.31%	49.69%	48.93%	49.28%
Male (N)	9,564	9,906	11,878	31,348
Male (Pct)	50.69%	50.31%	51.07%	50.72%
American Indian or Alaskan Native (N)	47	49	66	162
American Indian or Alaskan Native (Pct)	0.25%	0.25%	0.28%	0.26%
Black/African American non-Hispanic (N)	1,910	2,011	2,540	6,461
Black/African American non-Hispanic (Pct)	10.12%	10.21%	10.92%	10.45%
Hispanic (N)	2,507	2,582	3,266	8,355
Hispanic (Pct)	13.29%	13.11%	14.04%	13.52%
White/Caucasian non-Hispanic (N)	12,796	13,371	15,570	41,737
White/Caucasian non-Hispanic (Pct)	67.83%	67.91%	66.94%	67.52%
Multi-Racial non-Hispanic (N)	1,013	1,048	1,197	3,258
Multi-Racial non-Hispanic (Pct)	5.37%	5.32%	5.15%	5.27%
Asian non-Hispanic (N)	568	596	593	1,757
Asian non-Hispanic (Pct)	3.01%	3.03%	2.55%	2.84%
Native Hawaiian or Pacific Islander (N)	25	31	26	82
Native Hawaiian or Pacific Islander (Pct)	0.13%	0.16%	0.11%	0.13%
IEP (N)	67	132	174	373
IEP (Pct)	0.36%	0.67%	0.75%	0.60%
Migrant student (N)	0	1	0	1
Migrant student (Pct)	0.00%	0.01%	0.00%	0.00%
Economically disadvantaged (N)	74	50	85	209
Economically disadvantaged (Pct)	0.39%	0.25%	0.37%	0.34%
Number of students	18,866	19,688	23,258	61,812

Table 15–5. Demographic Characteristics of Students Taking CDT Math Grades 6–HS

Demographic or Educational Characteristic	Gr. 6	Gr. 7	Gr. 8	Gr. 9	Gr. 10	Gr. 11	Gr. 12	Total
Female (N)	13,392	15,760	13,482	170	30	14	10	42,858
Female (Pct)	48.62%	49.51%	49.13%	41.36%	40.00%	36.84%	52.63%	49.06%
Male (N)	14,150	16,071	13,962	241	45	24	9	44,502
Male (Pct)	51.38%	50.49%	50.87%	58.64%	60.00%	63.16%	47.37%	50.94%
American Indian or Alaskan Native (N)	65	266	292	0	0	1	0	624
American Indian or Alaskan Native (Pct)	0.24%	0.84%	1.06%	0.00%	0.00%	2.63%	0.00%	0.71%
Black/African American non-Hispanic (N)	2,840	3,034	2,943	31	9	4	8	8,869
Black/African American non-Hispanic (Pct)	10.31%	9.53%	10.72%	7.54%	12.00%	10.53%	42.11%	10.15%
Hispanic (N)	3,405	3,676	3,105	62	10	2	1	10,261
Hispanic (Pct)	12.36%	11.55%	11.31%	15.09%	13.33%	5.26%	5.26%	11.75%
White/Caucasian non-Hispanic (N)	19,089	22,369	18,973	285	54	28	10	60,808
White/Caucasian non-Hispanic (Pct)	69.31%	70.27%	69.13%	69.34%	72.00%	73.68%	52.63%	69.61%
Multi-Racial non-Hispanic (N)	1,375	1,680	1,515	19	0	1	0	4,590
Multi-Racial non-Hispanic (Pct)	4.99%	5.28%	5.52%	4.62%	0.00%	2.63%	0.00%	5.25%
Asian non-Hispanic (N)	737	783	586	10	1	1	0	2,118
Asian non-Hispanic (Pct)	2.68%	2.46%	2.14%	2.43%	1.33%	2.63%	0.00%	2.42%
Native Hawaiian or Pacific Islander (N)	31	23	30	4	1	1	0	90
Native Hawaiian or Pacific Islander (Pct)	0.11%	0.07%	0.11%	0.97%	1.33%	2.63%	0.00%	0.10%
IEP (N)	166	121	121	3	0	0	0	411
IEP (Pct)	0.60%	0.38%	0.44%	0.73%	0.00%	0.00%	0.00%	0.47%
Migrant student (N)	0	0	0	0	0	0	0	0
Migrant student (Pct)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Economically disadvantaged (N)	126	104	95	1	0	0	0	326
Economically disadvantaged (Pct)	0.46%	0.33%	0.35%	0.24%	0.00%	0.00%	0.00%	0.37%
Number of students	27,542	31,831	27,444	411	75	38	19	87,360

Table 15–6. Demographic Characteristics of Students Taking CDT Algebra I

Demographic or Educational Characteristic	Gr. 6	Gr. 7	Gr. 8	Gr. 9	Gr. 10	Gr. 11	Gr. 12	Total
Female (N)	49	543	3,262	12,702	4,308	1,272	263	22,399
Female (Pct)	35.00%	45.94%	51.69%	47.68%	44.32%	41.99%	40.71%	46.99%
Male (N)	91	639	3,049	13,937	5,412	1,757	383	25,268
Male (Pct)	65.00%	54.06%	48.31%	52.32%	55.68%	58.01%	59.29%	53.01%
American Indian or Alaskan Native (N)	0	1	19	351	39	15	2	427
American Indian or Alaskan Native (Pct)	0.00%	0.08%	0.30%	1.32%	0.40%	0.50%	0.31%	0.90%
Black/African American non-Hispanic (N)	5	9	196	3,167	1,566	597	132	5,672
Black/African American non-Hispanic (Pct)	3.57%	0.76%	3.11%	11.89%	16.11%	19.71%	20.43%	11.90%
Hispanic (N)	14	33	329	3,644	1,496	473	105	6,094
Hispanic (Pct)	10.00%	2.79%	5.21%	13.68%	15.39%	15.62%	16.25%	12.78%
White/Caucasian non-Hispanic (N)	102	1,021	5,323	17,621	6,010	1,748	369	32,194
White/Caucasian non-Hispanic (Pct)	72.86%	86.38%	84.34%	66.15%	61.83%	57.71%	57.12%	67.54%
Multi-Racial non-Hispanic (N)	9	42	242	1,309	466	148	25	2,241
Multi-Racial non-Hispanic (Pct)	6.43%	3.55%	3.83%	4.91%	4.79%	4.89%	3.87%	4.70%
Asian non-Hispanic (N)	10	76	192	526	134	43	12	993
Asian non-Hispanic (Pct)	7.14%	6.43%	3.04%	1.97%	1.38%	1.42%	1.86%	2.08%
Native Hawaiian or Pacific Islander (N)	0	0	10	21	9	5	1	46
Native Hawaiian or Pacific Islander (Pct)	0.00%	0.00%	0.16%	0.08%	0.09%	0.17%	0.15%	0.10%
IEP (N)	0	0	3	105	82	54	19	263
IEP (Pct)	0.00%	0.00%	0.05%	0.39%	0.84%	1.78%	2.94%	0.55%
Migrant student (N)	0	0	0	0	0	0	0	0
Migrant student (Pct)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Economically disadvantaged (N)	1	2	6	73	57	23	16	178
Economically disadvantaged (Pct)	0.71%	0.17%	0.10%	0.27%	0.59%	0.76%	2.48%	0.37%
Number of students	140	1,182	6,311	26,639	9,720	3,029	646	47,667

Table 15–7. Demographic Characteristics of Students Taking CDT Geometry

Demographic or Educational Characteristic	Gr. 6	Gr. 7	Gr. 8	Gr. 9	Gr. 10	Gr. 11	Gr. 12	Total
Female (N)	2	18	60	672	941	551	69	2,313
Female (Pct)	100.00%	50.00%	47.24%	50.64%	52.19%	45.35%	42.33%	49.50%
Male (N)	0	18	67	655	862	664	94	2,360
Male (Pct)	0.00%	50.00%	52.76%	49.36%	47.81%	54.65%	57.67%	50.50%
American Indian or Alaskan Native (N)	0	0	0	0	5	6	1	12
American Indian or Alaskan Native (Pct)	0.00%	0.00%	0.00%	0.00%	0.28%	0.49%	0.61%	0.26%
Black/African American non-Hispanic (N)	0	1	2	46	117	120	29	315
Black/African American non-Hispanic (Pct)	0.00%	2.78%	1.57%	3.47%	6.49%	9.88%	17.79%	6.74%
Hispanic (N)	0	2	7	60	164	155	28	416
Hispanic (Pct)	0.00%	5.56%	5.51%	4.52%	9.10%	12.76%	17.18%	8.90%
White/Caucasian non-Hispanic (N)	1	26	101	1,046	1,361	850	93	3,478
White/Caucasian non-Hispanic (Pct)	50.00%	72.22%	79.53%	78.82%	75.49%	69.96%	57.06%	74.43%
Multi-Racial non-Hispanic (N)	0	0	2	42	49	36	4	133
Multi-Racial non-Hispanic (Pct)	0.00%	0.00%	1.57%	3.17%	2.72%	2.96%	2.45%	2.85%
Asian non-Hispanic (N)	1	7	15	129	104	43	7	306
Asian non-Hispanic (Pct)	50.00%	19.44%	11.81%	9.72%	5.77%	3.54%	4.29%	6.55%
Native Hawaiian or Pacific Islander (N)	0	0	0	4	3	5	1	13
Native Hawaiian or Pacific Islander (Pct)	0.00%	0.00%	0.00%	0.30%	0.17%	0.41%	0.61%	0.28%
IEP (N)	0	0	0	3	4	1	0	8
IEP (Pct)	0.00%	0.00%	0.00%	0.23%	0.22%	0.08%	0.00%	0.17%
Migrant student (N)	0	0	0	0	0	0	0	0
Migrant student (Pct)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Economically disadvantaged (N)	0	0	0	0	0	0	0	0
Economically disadvantaged (Pct)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Number of students	2	36	127	1,327	1,803	1,215	163	4,673

Table 15–8. Demographic Characteristics of Students Taking CDT Algebra II

Demographic or Educational Characteristic	Gr. 6	Gr. 7	Gr. 8	Gr. 9	Gr. 10	Gr. 11	Gr. 12	Total
Female (N)	1	2	80	609	1,025	582	163	2,462
Female (Pct)	100.00%	25.00%	45.45%	52.23%	48.97%	51.83%	44.90%	49.94%
Male (N)	0	6	96	557	1,068	541	200	2,468
Male (Pct)	0.00%	75.00%	54.55%	47.77%	51.03%	48.17%	55.10%	50.06%
American Indian or Alaskan Native (N)	0	0	2	5	8	6	1	22
American Indian or Alaskan Native (Pct)	0.00%	0.00%	1.14%	0.43%	0.38%	0.53%	0.28%	0.45%
Black/African American non-Hispanic (N)	0	0	1	33	92	60	43	229
Black/African American non-Hispanic (Pct)	0.00%	0.00%	0.57%	2.83%	4.40%	5.34%	11.85%	4.65%
Hispanic (N)	0	0	3	50	156	92	81	382
Hispanic (Pct)	0.00%	0.00%	1.70%	4.29%	7.45%	8.19%	22.31%	7.75%
White/Caucasian non-Hispanic (N)	0	5	143	939	1,624	894	213	3,818
White/Caucasian non-Hispanic (Pct)	0.00%	62.50%	81.25%	80.53%	77.59%	79.61%	58.68%	77.44%
Multi-Racial non-Hispanic (N)	0	0	5	31	60	15	13	124
Multi-Racial non-Hispanic (Pct)	0.00%	0.00%	2.84%	2.66%	2.87%	1.34%	3.58%	2.52%
Asian non-Hispanic (N)	1	3	22	108	151	52	11	348
Asian non-Hispanic (Pct)	100.00%	37.50%	12.50%	9.26%	7.21%	4.63%	3.03%	7.06%
Native Hawaiian or Pacific Islander (N)	0	0	0	0	2	4	1	7
Native Hawaiian or Pacific Islander (Pct)	0.00%	0.00%	0.00%	0.00%	0.10%	0.36%	0.28%	0.14%
IEP (N)	0	0	0	2	2	1	1	6
IEP (Pct)	0.00%	0.00%	0.00%	0.17%	0.10%	0.09%	0.28%	0.12%
Migrant student (N)	0	0	0	0	0	0	0	0
Migrant student (Pct)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Economically disadvantaged (N)	0	0	0	1	1	0	0	2
Economically disadvantaged (Pct)	0.00%	0.00%	0.00%	0.09%	0.05%	0.00%	0.00%	0.04%
Number of students	1	8	176	1,166	2,093	1,123	363	4,930

Table 15–9. Demographic Characteristics of Students Taking CDT Reading Grades 3–5

Demographic or Educational Characteristic	Gr. 3	Gr. 4	Gr. 5	Total
Female (N)	8,216	9,029	9,904	27,149
Female (Pct)	49.34%	49.75%	48.95%	49.33%
Male (N)	8,437	9,118	10,330	27,885
Male (Pct)	50.66%	50.25%	51.05%	50.67%
American Indian or Alaskan Native (N)	37	41	50	128
American Indian or Alaskan Native (Pct)	0.22%	0.23%	0.25%	0.23%
Black/African American non-Hispanic (N)	1,640	1,714	2,078	5,432
Black/African American non-Hispanic (Pct)	9.85%	9.45%	10.27%	9.87%
Hispanic (N)	2,104	2,347	2,546	6,997
Hispanic (Pct)	12.63%	12.93%	12.58%	12.71%
White/Caucasian non-Hispanic (N)	11,390	12,492	13,959	37,841
White/Caucasian non-Hispanic (Pct)	68.40%	68.84%	68.99%	68.76%
Multi-Racial non-Hispanic (N)	914	968	1,029	2,911
Multi-Racial non-Hispanic (Pct)	5.49%	5.33%	5.09%	5.29%
Asian non-Hispanic (N)	551	561	551	1,663
Asian non-Hispanic (Pct)	3.31%	3.09%	2.72%	3.02%
Native Hawaiian or Pacific Islander (N)	17	24	21	62
Native Hawaiian or Pacific Islander (Pct)	0.10%	0.13%	0.10%	0.11%
IEP (N)	57	93	132	282
IEP (Pct)	0.34%	0.51%	0.65%	0.51%
Migrant student (N)	0	0	0	0
Migrant student (Pct)	0.00%	0.00%	0.00%	0.00%
Economically disadvantaged (N)	68	69	76	213
Economically disadvantaged (Pct)	0.41%	0.38%	0.38%	0.39%
Number of students	16,653	18,147	20,234	55,034

Table 15–10. Demographic Characteristics of Students Taking CDT Reading/Lit Grades 6–HS

Demographic or Educational Characteristic	Gr. 6	Gr. 7	Gr. 8	Gr. 9	Gr. 10	Gr. 11	Gr. 12	Total
Female (N)	10,987	12,325	12,194	11,220	17,020	2,702	642	67,090
Female (Pct)	48.61%	49.33%	49.31%	47.81%	48.90%	43.50%	44.68%	48.53%
Male (N)	11,614	12,662	12,534	12,247	17,785	3,510	795	71,147
Male (Pct)	51.39%	50.67%	50.69%	52.19%	51.10%	56.50%	55.32%	51.47%
American Indian or Alaskan Native (N)	42	240	271	61	80	16	4	714
American Indian or Alaskan Native (Pct)	0.19%	0.96%	1.10%	0.26%	0.23%	0.26%	0.28%	0.52%
Black/African American non-Hispanic (N)	2,134	2,358	2,333	2,255	3,180	791	250	13,301
Black/African American non-Hispanic (Pct)	9.44%	9.44%	9.43%	9.61%	9.14%	12.73%	17.40%	9.62%
Hispanic (N)	2,844	2,989	2,588	2,589	3,357	855	219	15,441
Hispanic (Pct)	12.58%	11.96%	10.47%	11.03%	9.65%	13.76%	15.24%	11.17%
White/Caucasian non-Hispanic (N)	15,898	17,469	17,646	16,725	25,630	4,231	902	98,501
White/Caucasian non-Hispanic (Pct)	70.34%	69.91%	71.36%	71.27%	73.64%	68.11%	62.77%	71.26%
Multi-Racial non-Hispanic (N)	1,078	1,357	1,348	1,051	1,344	221	46	6,445
Multi-Racial non-Hispanic (Pct)	4.77%	5.43%	5.45%	4.48%	3.86%	3.56%	3.20%	4.66%
Asian non-Hispanic (N)	576	561	512	768	1,180	91	14	3,702
Asian non-Hispanic (Pct)	2.55%	2.25%	2.07%	3.27%	3.39%	1.46%	0.97%	2.68%
Native Hawaiian or Pacific Islander (N)	29	13	30	18	34	7	2	133
Native Hawaiian or Pacific Islander (Pct)	0.13%	0.05%	0.12%	0.08%	0.10%	0.11%	0.14%	0.10%
IEP (N)	112	125	131	96	107	54	26	651
IEP (Pct)	0.50%	0.50%	0.53%	0.41%	0.31%	0.87%	1.81%	0.47%
Migrant student (N)	0	0	0	0	0	0	0	0
Migrant student (Pct)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Economically disadvantaged (N)	118	107	95	79	100	42	36	577
Economically disadvantaged (Pct)	0.52%	0.43%	0.38%	0.34%	0.29%	0.68%	2.51%	0.42%
Number of students	22,601	24,987	24,728	23,467	34,805	6,212	1,437	138,237

Table 15–11. Demographic Characteristics of Students Taking CDT Science Grades 3–5

Demographic or Educational Characteristic	Gr. 3	Gr. 4	Gr. 5	Total
Female (N)	1,024	5,342	2,200	8,566
Female (Pct)	49.83%	49.28%	49.21%	49.32%
Male (N)	1,031	5,499	2,271	8,801
Male (Pct)	50.17%	50.72%	50.79%	50.68%
American Indian or Alaskan Native (N)	3	25	9	37
American Indian or Alaskan Native (Pct)	0.15%	0.23%	0.20%	0.21%
Black/African American non-Hispanic (N)	533	1,457	593	2,583
Black/African American non-Hispanic (Pct)	25.94%	13.44%	13.26%	14.87%
Hispanic (N)	454	2,085	1,074	3,613
Hispanic (Pct)	22.09%	19.23%	24.02%	20.80%
White/Caucasian non-Hispanic (N)	873	6,415	2,469	9,757
White/Caucasian non-Hispanic (Pct)	42.48%	59.17%	55.22%	56.18%
Multi-Racial non-Hispanic (N)	110	584	218	912
Multi-Racial non-Hispanic (Pct)	5.35%	5.39%	4.88%	5.25%
Asian non-Hispanic (N)	78	259	104	441
Asian non-Hispanic (Pct)	3.80%	2.39%	2.33%	2.54%
Native Hawaiian or Pacific Islander (N)	4	16	4	24
Native Hawaiian or Pacific Islander (Pct)	0.19%	0.15%	0.09%	0.14%
IEP (N)	2	36	5	43
IEP (Pct)	0.10%	0.33%	0.11%	0.25%
Migrant student (N)	0	0	0	0
Migrant student (Pct)	0.00%	0.00%	0.00%	0.00%
Economically disadvantaged (N)	4	68	30	102
Economically disadvantaged (Pct)	0.19%	0.63%	0.67%	0.59%
Number of students	2,055	10,841	4,471	17,367

Table 15–12. Demographic Characteristics of Students Taking CDT Science Grades 6–HS

Demographic or Educational Characteristic	Gr. 6	Gr. 7	Gr. 8	Gr. 9	Gr. 10	Gr. 11	Gr. 12	Total
Female (N)	5,960	10,397	14,502	624	107	128	78	31,796
Female (Pct)	48.76%	49.52%	48.92%	43.82%	39.19%	46.04%	42.86%	48.90%
Male (N)	6,263	10,597	15,142	800	166	150	104	33,222
Male (Pct)	51.24%	50.48%	51.08%	56.18%	60.81%	53.96%	57.14%	51.10%
American Indian or Alaskan Native (N)	37	31	276	5	1	1	0	351
American Indian or Alaskan Native (Pct)	0.30%	0.15%	0.93%	0.35%	0.37%	0.36%	0.00%	0.54%
Black/African American non-Hispanic (N)	1,195	2,284	3,280	226	49	20	13	7,067
Black/African American non-Hispanic (Pct)	9.78%	10.88%	11.06%	15.87%	17.95%	7.19%	7.14%	10.87%
Hispanic (N)	1,687	3,086	3,505	407	70	107	92	8,954
Hispanic (Pct)	13.80%	14.70%	11.82%	28.58%	25.64%	38.49%	50.55%	13.77%
White/Caucasian non-Hispanic (N)	8,235	13,949	20,284	678	125	139	68	43,478
White/Caucasian non-Hispanic (Pct)	67.37%	66.44%	68.43%	47.61%	45.79%	50.00%	37.36%	66.87%
Multi-Racial non-Hispanic (N)	687	1,100	1,584	83	17	6	4	3,481
Multi-Racial non-Hispanic (Pct)	5.62%	5.24%	5.34%	5.83%	6.23%	2.16%	2.20%	5.35%
Asian non-Hispanic (N)	369	530	677	21	11	4	4	1,616
Asian non-Hispanic (Pct)	3.02%	2.52%	2.28%	1.47%	4.03%	1.44%	2.20%	2.49%
Native Hawaiian or Pacific Islander (N)	13	14	38	4	0	1	1	71
Native Hawaiian or Pacific Islander (Pct)	0.11%	0.07%	0.13%	0.28%	0.00%	0.36%	0.55%	0.11%
IEP (N)	36	42	119	25	16	11	3	252
IEP (Pct)	0.29%	0.20%	0.40%	1.76%	5.86%	3.96%	1.65%	0.39%
Migrant student (N)	1	0	0	0	0	0	0	1
Migrant student (Pct)	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Economically disadvantaged (N)	97	72	104	6	2	0	0	281
Economically disadvantaged (Pct)	0.79%	0.34%	0.35%	0.42%	0.73%	0.00%	0.00%	0.43%
Number of students	12,223	20,994	29,644	1,424	273	278	182	65,018

Table 15–13. Demographic Characteristics of Students Taking CDT Biology

Demographic or Educational Characteristic	Gr. 6	Gr. 7	Gr. 8	Gr. 9	Gr. 10	Gr. 11	Gr. 12	Total
Female (N)	0	11	74	12,181	11,476	1,785	280	25,807
Female (Pct)	N/A	64.71%	51.03%	50.32%	46.86%	44.40%	46.36%	48.25%
Male (N)	0	6	71	12,027	13,013	2,235	324	27,676
Male (Pct)	N/A	35.29%	48.97%	49.68%	53.14%	55.60%	53.64%	51.75%
American Indian or Alaskan Native (N)	0	0	0	109	118	17	1	245
American Indian or Alaskan Native (Pct)	N/A	0.00%	0.00%	0.45%	0.48%	0.42%	0.17%	0.46%
Black/African American non-Hispanic (N)	0	0	5	1,955	2,881	574	110	5,525
Black/African American non-Hispanic (Pct)	N/A	0.00%	3.45%	8.08%	11.76%	14.28%	18.21%	10.33%
Hispanic (N)	0	1	6	2,362	3,475	1,161	255	7,260
Hispanic (Pct)	N/A	5.88%	4.14%	9.76%	14.19%	28.88%	42.22%	13.57%
White/Caucasian non-Hispanic (N)	0	16	122	17,922	16,385	2,000	200	36,645
White/Caucasian non-Hispanic (Pct)	N/A	94.12%	84.14%	74.03%	66.91%	49.75%	33.11%	68.52%
Multi-Racial non-Hispanic (N)	0	0	3	935	963	176	20	2,097
Multi-Racial non-Hispanic (Pct)	N/A	0.00%	2.07%	3.86%	3.93%	4.38%	3.31%	3.92%
Asian non-Hispanic (N)	0	0	8	898	630	89	15	1,640
Asian non-Hispanic (Pct)	N/A	0.00%	5.52%	3.71%	2.57%	2.21%	2.48%	3.07%
Native Hawaiian or Pacific Islander (N)	0	0	1	27	37	3	3	71
Native Hawaiian or Pacific Islander (Pct)	N/A	0.00%	0.69%	0.11%	0.15%	0.07%	0.50%	0.13%
IEP (N)	0	0	0	72	77	29	13	191
IEP (Pct)	N/A	0.00%	0.00%	0.30%	0.31%	0.72%	2.15%	0.36%
Migrant student (N)	0	0	0	0	0	0	0	0
Migrant student (Pct)	N/A	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Economically disadvantaged (N)	0	0	0	55	57	30	17	159
Economically disadvantaged (Pct)	N/A	0.00%	0.00%	0.23%	0.23%	0.75%	2.81%	0.30%
Number of students	0	17	145	24,208	24,489	4,020	604	53,483

Table 15–14. Demographic Characteristics of Students Taking CDT Chemistry

Demographic or Educational Characteristic	Gr. 6	Gr. 7	Gr. 8	Gr. 9	Gr. 10	Gr. 11	Gr. 12	Total
Female (N)	0	0	0	384	742	504	64	1,694
Female (Pct)	N/A	N/A	0.00%	48.48%	55.58%	46.28%	44.14%	50.34%
Male (N)	0	0	4	408	593	585	81	1,671
Male (Pct)	N/A	N/A	100.00%	51.52%	44.42%	53.72%	55.86%	49.66%
American Indian or Alaskan Native (N)	0	0	0	2	3	1	2	8
American Indian or Alaskan Native (Pct)	N/A	N/A	0.00%	0.25%	0.22%	0.09%	1.38%	0.24%
Black/African American non-Hispanic (N)	0	0	0	43	56	60	21	180
Black/African American non-Hispanic (Pct)	N/A	N/A	0.00%	5.43%	4.19%	5.51%	14.48%	5.35%
Hispanic (N)	0	0	1	40	84	160	36	321
Hispanic (Pct)	N/A	N/A	25.00%	5.05%	6.29%	14.69%	24.83%	9.54%
White/Caucasian non-Hispanic (N)	0	0	2	637	1,055	803	78	2,575
White/Caucasian non-Hispanic (Pct)	N/A	N/A	50.00%	80.43%	79.03%	73.74%	53.79%	76.52%
Multi-Racial non-Hispanic (N)	0	0	0	30	60	42	5	137
Multi-Racial non-Hispanic (Pct)	N/A	N/A	0.00%	3.79%	4.49%	3.86%	3.45%	4.07%
Asian non-Hispanic (N)	0	0	1	39	75	23	3	141
Asian non-Hispanic (Pct)	N/A	N/A	25.00%	4.92%	5.62%	2.11%	2.07%	4.19%
Native Hawaiian or Pacific Islander (N)	0	0	0	1	2	0	0	3
Native Hawaiian or Pacific Islander (Pct)	N/A	N/A	0.00%	0.13%	0.15%	0.00%	0.00%	0.09%
IEP (N)	0	0	1	2	3	2	2	10
IEP (Pct)	N/A	N/A	25.00%	0.25%	0.22%	0.18%	1.38%	0.30%
Migrant student (N)	0	0	0	0	0	0	0	0
Migrant student (Pct)	N/A	N/A	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Economically disadvantaged (N)	0	0	0	0	1	1	0	2
Economically disadvantaged (Pct)	N/A	N/A	0.00%	0.00%	0.07%	0.09%	0.00%	0.06%
Number of students	0	0	4	792	1,335	1,089	145	3,365

Table 15–15. Demographic Characteristics of Students Taking CDT Writing Grades 3–5

Demographic or Educational Characteristic	Gr. 3	Gr. 4	Gr. 5	Total
Female (N)	1,264	1,513	2,102	4,879
Female (Pct)	49.34%	49.64%	50.37%	49.87%
Male (N)	1,298	1,535	2,071	4,904
Male (Pct)	50.66%	50.36%	49.63%	50.13%
American Indian or Alaskan Native (N)	11	17	23	51
American Indian or Alaskan Native (Pct)	0.43%	0.56%	0.55%	0.52%
Black/African American non-Hispanic (N)	328	396	429	1,153
Black/African American non-Hispanic (Pct)	12.80%	12.99%	10.28%	11.79%
Hispanic (N)	475	475	818	1,768
Hispanic (Pct)	18.54%	15.58%	19.60%	18.07%
White/Caucasian non-Hispanic (N)	1,588	1,951	2,680	6,219
White/Caucasian non-Hispanic (Pct)	61.98%	64.01%	64.22%	63.57%
Multi-Racial non-Hispanic (N)	124	175	187	486
Multi-Racial non-Hispanic (Pct)	4.84%	5.74%	4.48%	4.97%
Asian non-Hispanic (N)	30	32	30	92
Asian non-Hispanic (Pct)	1.17%	1.05%	0.72%	0.94%
Native Hawaiian or Pacific Islander (N)	6	2	6	14
Native Hawaiian or Pacific Islander (Pct)	0.23%	0.07%	0.14%	0.14%
IEP (N)	17	44	44	105
IEP (Pct)	0.66%	1.44%	1.05%	1.07%
Migrant student (N)	0	0	0	0
Migrant student (Pct)	0.00%	0.00%	0.00%	0.00%
Economically disadvantaged (N)	23	11	30	64
Economically disadvantaged (Pct)	0.90%	0.36%	0.72%	0.65%
Number of students	2,562	3,048	4,173	9,783

Table 15–16. Demographic Characteristics of Students Taking CDT Writing/Eng Comp Grades 6–HS

Demographic or Educational Characteristic	Gr. 6	Gr. 7	Gr. 8	Gr. 9	Gr. 10	Gr. 11	Gr. 12	Total
Female (N)	2,800	3,964	4,062	685	1,115	419	146	13,191
Female (Pct)	48.54%	49.44%	49.14%	47.08%	48.71%	45.30%	49.49%	48.82%
Male (N)	2,969	4,054	4,205	770	1,174	506	149	13,827
Male (Pct)	51.46%	50.56%	50.86%	52.92%	51.29%	54.70%	50.51%	51.18%
American Indian or Alaskan Native (N)	23	21	34	2	6	2	1	89
American Indian or Alaskan Native (Pct)	0.40%	0.26%	0.41%	0.14%	0.26%	0.22%	0.34%	0.33%
Black/African American non-Hispanic (N)	524	678	734	163	220	80	32	2,431
Black/African American non-Hispanic (Pct)	9.08%	8.46%	8.88%	11.20%	9.61%	8.65%	10.85%	9.00%
Hispanic (N)	574	807	876	252	313	131	88	3,041
Hispanic (Pct)	9.95%	10.06%	10.60%	17.32%	13.67%	14.16%	29.83%	11.26%
White/Caucasian non-Hispanic (N)	4,280	5,874	6,012	903	1,562	654	164	19,449
White/Caucasian non-Hispanic (Pct)	74.19%	73.26%	72.72%	62.06%	68.24%	70.70%	55.59%	71.99%
Multi-Racial non-Hispanic (N)	265	396	374	89	107	28	7	1,266
Multi-Racial non-Hispanic (Pct)	4.59%	4.94%	4.52%	6.12%	4.67%	3.03%	2.37%	4.69%
Asian non-Hispanic (N)	93	231	224	43	79	28	3	701
Asian non-Hispanic (Pct)	1.61%	2.88%	2.71%	2.96%	3.45%	3.03%	1.02%	2.59%
Native Hawaiian or Pacific Islander (N)	10	11	13	3	2	2	0	41
Native Hawaiian or Pacific Islander (Pct)	0.17%	0.14%	0.16%	0.21%	0.09%	0.22%	0.00%	0.15%
IEP (N)	67	26	29	7	4	2	1	136
IEP (Pct)	1.16%	0.32%	0.35%	0.48%	0.17%	0.22%	0.34%	0.50%
Migrant student (N)	0	0	0	0	0	0	0	0
Migrant student (Pct)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Economically disadvantaged (N)	76	56	59	8	4	2	0	205
Economically disadvantaged (Pct)	1.32%	0.70%	0.71%	0.55%	0.17%	0.22%	0.00%	0.76%
Number of students	5,769	8,018	8,267	1,455	2,289	925	295	27,018

SUMMARY STATISTICS—TEST LENGTH

The analyses from here until the section titled "Multiple Administrations of the Same CDT Test" include all records in the full CDT operational assessments. When a student took CDT Math Grades 6–HS twice, for example, both records were used in the analyses.

As noted in Chapter Thirteen, full CDT tests have either four or five diagnostic categories. On tests with five diagnostic categories (Reading Grades 3–5, Reading/Lit Grades 6–HS, Writing Grades 3–5, and Writing/Eng Comp Grades 6–HS), students take between 10 and 12 operational items per diagnostic category for a total test of 50 to 60 operational items. On tests with four diagnostic categories (Math Grades 3–5, Math Grades 6–HS, Algebra I, Geometry, Algebra II, Science Grades 3–5, Science Grades 6–HS, Biology, and Chemistry), students take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items.

Tables 15–17a and 15–17b show the summary statistics for the test length for each assessment. Summary statistics are based on the number of items presented to the student and include minimum, maximum, quartiles 1 and 3, mean, and median.

Table 15–17a. Summary Statistics for Full CDT Test Length (Number of Operational Items Administered)

CDT	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Math Grades 3–5	106,975	48	50	51	51.67	53	60
Math Grades 6–HS	148,191	48	50	52	52.21	54	60
Algebra I	76,958	48	50	52	52.80	55	60
Geometry	8,595	48	50	52	52.55	54	60
Algebra II	8,299	48	51	53	52.94	55	60
Reading Grades 3–5	100,466	50	54	55	55.16	57	60
Reading/Lit Grades 6–HS	225,797	50	54	55	55.35	57	60
Science Grades 3–5	31,023	48	50	51	51.35	53	60
Science Grades 6–HS	94,759	48	50	52	52.23	54	60
Biology	87,485	48	50	52	52.47	55	60
Chemistry	6,302	48	50	53	53.02	56	60
Writing Grades 3–5	13,695	50	53	55	54.71	56	60
Writing/Eng Comp Gr 6–HS	38,499	50	54	55	55.61	57	60

The minimum number of items was quite similar, ranging from 48 to 50. The mean and median were higher for tests in the reading and writing content areas, which have five diagnostic categories. The maximum number of items administered was fixed at 60 for all CDT tests.

Table 15–17b. Summary Statistics for Diagnostic Category CDT Test Length (Number of Operational Items Administered)

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Math Grades 3–5	Numbers and Operations	28,648	15	15	16	16.26	17	18
Math Grades 3–5	Algebraic Concepts	9,239	15	15	16	16.41	18	18
Math Grades 3–5	Geometry	3,054	15	15	16	16.53	18	18
Math Grades 3–5	Measurement, Data, and Probability	3,507	15	15	16	16.41	18	18
Math Grades 6–HS	Numbers and Operations	25,995	15	15	16	16.31	17	18
Math Grades 6–HS	Algebraic Concepts	22,309	15	15	16	16.46	18	18
Math Grades 6–HS	Geometry	6,532	15	16	16	16.54	18	18
Math Grades 6–HS	Measurement, Data, and Probability	4,323	15	16	16	16.54	18	18
Algebra I	Operations with Real Numbers and Expressions	5,547	15	15	16	16.54	18	18
Algebra I	Linear Equations & Inequalities	8,643	15	15	16	16.41	18	18
Algebra I	Functions & Coordinate Geometry	5,336	15	15	16	16.43	18	18
Algebra I	Data Analysis	2,999	15	16	16	16.56	18	18
Geometry	Geometric Properties	128	15	15	16	16.28	18	18
Geometry	Congruence, Similarity, and Proofs	123	15	16	17	16.69	18	18
Geometry	Coordinate Geometry and Right Triangles	255	15	16	17	16.84	18	18
Geometry	Measurement	341	15	15	16	16.45	18	18
Algebra II	Operations with Complex Numbers	583	15	16	17	16.94	18	18
Algebra II	Non-Linear Expressions & Equations	325	15	15	16	16.25	17	18
Algebra II	Functions	357	15	15	16	16.53	18	18
Algebra II	Data Analysis	171	15	15	16	16.35	18	18

Table 15–17b (continued). Summary Statistics for Diagnostic Category CDT Test Length (Number of Operational Items Administered)

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Reading Grades 3–5	Informational Text	12,482	30	32	33	32.94	34	36
Reading Grades 3–5	Literature Text	14,441	30	32	33	32.82	34	36
Reading/Lit Grades 6–HS	Informational Text	31,522	30	32	33	32.77	34	36
Reading/Lit Grades 6–HS	Literature Text	29,445	30	32	33	32.94	34	36
Science Grades 3–5	The Nature of Science	2,949	15	15	16	16.34	18	18
Science Grades 3–5	Biological Sciences	1,654	15	15	16	16.47	18	18
Science Grades 3–5	Physical Sciences	1,832	15	15	16	16.43	18	18
Science Grades 3–5	Earth and Space Sciences	1,436	15	15	16	16.50	18	18
Science Grades 6–HS	The Nature of Science	24,036	15	15	16	16.22	17	18
Science Grades 6–HS	Biological Sciences	11,156	15	15	16	16.35	18	18
Science Grades 6–HS	Physical Sciences	8,913	15	15	16	16.48	18	18
Science Grades 6–HS	Earth and Space Sciences	7,761	15	15	16	16.40	18	18
Biology	Basic Biological Principles/ Chemical Basis for Life	12,168	15	15	16	16.38	17	18
Biology	Bioenergetics/ Homeostasis and Transport	7,490	15	15	16	16.40	18	18
Biology	Cell Growth and Reproduction/ Genetics	4,023	15	16	16	16.55	18	18
Biology	Theory of Evolution/ Ecology	4,701	15	15	16	16.39	18	18
Chemistry	Properties and Classification of Matter	164	15	16	17	16.88	18	18
Chemistry	Atomic Structure and The Periodic Table	772	15	15	16	16.44	18	18

Table 15–17b (continued). Summary Statistics for Diagnostic Category CDT Test Length (Number of Operational Items Administered)

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Chemistry	The Mole and Chemical Bonding	48	15	16	18	17.23	18	18
Chemistry	Chemical Relationships and Reactions	51	15	16	18	17.12	18	18
Writing Grades 3–5	Quality of Writing: Focus and Organization	806	15	15	16	16.26	17	18
Writing Grades 3–5	Quality of Writing: Content and Style	148	15	15	16	16.11	17	18
Writing Grades 3–5	Quality of Writing: Editing	107	15	15	16	16.42	18	18
Writing Grades 3–5	Conventions: Punctuation, Capitalization, and Spelling	4,071	15	15	16	16.37	18	18
Writing Grades 3–5	Conventions: Grammar and Sentence Formation	4,734	15	15	16	16.38	18	18
Writing/Eng Comp Gr 6–HS	Quality of Writing: Focus and Organization	2,006	15	15	16	16.32	17	18
Writing/Eng Comp Gr 6–HS	Quality of Writing: Content and Style	960	15	16	16	16.65	18	18
Writing/Eng Comp Gr 6–HS	Quality of Writing: Editing	481	15	15	16	16.43	18	18
Writing/Eng Comp Gr 6–HS	Conventions: Punctuation, Capitalization, and Spelling	6,443	15	16	16	16.58	18	18
Writing/Eng Comp Gr 6–HS	Conventions: Grammar and Sentence Formation	7,396	15	15	16	16.44	18	18

All diagnostic category CDTs in the math, science and writing content areas focus on a single diagnostic category. Tests range from 15 to 18 items. Diagnostic category CDTs in the reading content area focus on a single text type with three diagnostic categories. Tests range from 30 to 36 items.

SUMMARY STATISTICS—SCALE SCORES AND CONDITIONAL STANDARD ERRORS

Tables 15–18a and 15–18b show the summary statistics for the scale scores. Tests with multiple benchmark cuts are broken down to match the grade level of the cuts. Tests that are course-specific are not broken down.

Table 15–18a. Summary Statistics for Scale Score Based on Full CDT

CDT	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Math – G3	32,556	200	581	704	694.60	809	1446
Math – G4	33,809	296	680	793	784.87	893	1435
Math – G5	40,610	235	729	840	828.81	937	1590
Math – G6	47,976	376	797	909	902.12	1009	1776
Math – G7	53,789	431	838	950	940.06	1047	1641
Math – G8	45,784	439	856	977	961.11	1072	1616
Math – HS	642	392	797	917	900.74	1011	1210
Algebra I	76,958	461	884	1006	986.26	1096	1820
Geometry	8,595	400	968	1068	1054.16	1155	1727
Algebra II	8,299	537	1001	1106	1092.50	1196	1779
Reading – G3	29,868	256	586	685	706.44	817	1420
Reading – G4	32,775	380	654	783	785.39	910	1372
Reading – G5	37,823	300	714	852	844.42	970	1325
Reading – G6	40,440	317	771	898	887.65	998	1371
Reading – G7	41,229	405	782	920	904.99	1022	1476
Reading – G8	40,378	460	796	932	920.70	1040	1455
Literature	103,750	458	845	992	970.42	1094	1563
Science – G3	3,319	200	532	690	661.22	798	1147
Science – G4	19,845	222	639	765	740.38	857	1325
Science – G5	7,859	279	657	778	762.43	882	1307
Science – G6	18,008	349	694	819	804.31	914	1365
Science – G7	28,568	200	719	847	830.63	944	1325
Science – G8	45,976	425	745	881	858.76	974	1378
Science – HS	2,207	476	705	840	830.29	955	1318
Biology	87,485	427	826	944	930.51	1033	1584
Chemistry	6,302	499	882	970	958.88	1042	1343
Writing – G3	3,669	256	527	703	679.47	821	1122
Writing – G4	4,424	277	619	782	752.19	890	1139
Writing – G5	5,602	259	702	841	812.80	940	1266
Writing – G6	8,801	370	762	900	873.76	990	1318
Writing – G7	11,917	388	786	931	901.33	1028	1350
Writing – G8	11,553	447	773	935	902.26	1036	1381
English Composition	6,228	380	712	921	887.93	1047	1524

Table 15–18b. Summary Statistics for Scale Score Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Math – G3	Numbers and Operations	8,613	200	564	688	678.65	794	1439
Math – G3	Algebraic Concepts	3,305	200	557	727	711.23	857	1296
Math – G3	Geometry	1,423	200	531	660	645.95	767	1221
Math – G3	Measurement, Data, and Probability	1,178	200	550	709	695.62	845	1237
Math – G4	Numbers and Operations	8,580	200	680	799	787.44	901	1647
Math – G4	Algebraic Concepts	3,546	200	635	802	786.46	949	1293
Math – G4	Geometry	737	200	619	743	748.66	879	1366
Math – G4	Measurement, Data, and Probability	1,157	200	524	662	691.84	853	1277
Math – G5	Numbers and Operations	11,455	200	739	856	846.79	965	1692
Math – G5	Algebraic Concepts	2,388	200	716	839	825.09	953	1359
Math – G5	Geometry	894	200	670	788	797.08	929	1718
Math – G5	Measurement, Data, and Probability	1,172	200	632	765	757.83	885	1316
Math – G6	Numbers and Operations	9,710	200	804	920	914.84	1042	1576
Math – G6	Algebraic Concepts	5,750	269	836	959	940.78	1067	1629
Math – G6	Geometry	1,616	344	785	904	894.01	1004	1529
Math – G6	Measurement, Data, and Probability	1,491	337	748	874	874.91	1004	1539
Math – G7	Numbers and Operations	8,478	300	834	960	944.65	1073	1579
Math – G7	Algebraic Concepts	8,825	200	828	964	941.08	1069	1494
Math – G7	Geometry	2,535	200	803	925	919.14	1035	1684
Math – G7	Measurement, Data, and Probability	1,522	355	775	918	913.80	1061	1486
Math – G8	Numbers and Operations	7,628	200	854	993	964.97	1108	1498
Math – G8	Algebraic Concepts	7,668	210	825	971	949.77	1077	1558

Table 15–18b (continued). Summary Statistics for Scale Score Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Math – G8	Geometry	2,381	276	822	943	943.01	1063	1547
Math – G8	Measurement, Data, and Probability	1,310	382	778	936	926.37	1072	1605
Math – HS	Numbers and Operations	179	385	746	896	882.39	1030	1298
Math – HS	Algebraic Concepts	66	411	675	837	823.86	920	1403
Math – HS	Geometry	0	0	0	0	0.00	0	0
Math – HS	Measurement, Data, and Probability	0	0	0	0	0.00	0	0
Algebra I	Operations with Real Numbers and Expressions	5,547	400	907	1038	1011.28	1137	1639
Algebra I	Linear Equations & Inequalities	8,643	407	932	1050	1037.68	1140	1815
Algebra I	Functions & Coordinate Geometry	5,336	462	946	1045	1035.29	1136	1819
Algebra I	Data Analysis	2,999	400	903	1018	1001.03	1112	1581
Geometry	Geometric Properties	128	440	975	1158	1085.12	1221	1485
Geometry	Congruence, Similarity, and Proofs	123	422	1038	1141	1132.40	1291	1651
Geometry	Coordinate Geometry and Right Triangles	255	523	976	1115	1103.01	1240	1777
Geometry	Measurement	341	445	974	1114	1083.92	1202	1528
Algebra II	Operations with Complex Numbers	583	559	1076	1207	1232.99	1371	1847
Algebra II	Non-Linear Expressions & Equations	325	671	1107	1188	1186.95	1284	1645
Algebra II	Functions	357	607	1042	1163	1145.90	1251	1459
Algebra II	Data Analysis	171	554	1082	1164	1143.29	1230	1439
Reading – G3	Informational Text	3,770	217	567	667	688.34	803	1244
Reading – G3	Literature Text	4,710	200	562	659	684.13	798	1325

Table 15–18b (continued). Summary Statistics for Scale Score Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Reading – G4	Informational Text	3,041	200	589	696	725.78	858	1420
Reading – G4	Literature Text	5,220	227	626	786	777.16	921	1347
Reading – G5	Informational Text	5,671	278	661	803	801.71	936	1282
Reading – G5	Literature Text	4,511	200	700	855	841.71	979	1317
Reading – G6	Informational Text	7,066	305	712	850	846.49	974	1439
Reading – G6	Literature Text	5,111	384	771	902	883.59	996	1494
Reading – G7	Informational Text	6,539	210	735	892	876.30	1010	1454
Reading – G7	Literature Text	6,075	381	768	910	895.10	1019	1453
Reading – G8	Informational Text	6,003	389	760	922	902.24	1036	1508
Reading – G8	Literature Text	5,927	367	778	920	910.04	1037	1456
Literature	Informational Text	11,914	205	860	1006	976.80	1102	1594
Literature	Literature Text	12,332	343	863	1007	983.17	1108	1710
Science – G3	The Nature of Science	2	289	289	476	475.50	0	662
Science – G3	Biological Sciences	71	371	714	798	782.25	891	1025
Science – G3	Physical Sciences	2	330	330	480	480.00	0	630
Science – G3	Earth and Space Sciences	2	520	520	571	571.00	0	622
Science – G4	The Nature of Science	1,612	200	462	634	636.99	810	1235
Science – G4	Biological Sciences	1,458	200	439	592	607.71	769	1224
Science – G4	Physical Sciences	1,415	200	426	627	613.00	789	1202
Science – G4	Earth and Space Sciences	1,373	200	468	581	610.74	759	1171
Science – G5	The Nature of Science	1,335	200	740	867	841.50	958	1301
Science – G5	Biological Sciences	125	340	770	876	869.65	967	1313
Science – G5	Physical Sciences	415	259	776	874	856.60	957	1279
Science – G5	Earth and Space Sciences	61	469	722	808	805.11	884	1123

Table 15–18b (continued). Summary Statistics for Scale Score Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Science – G6	The Nature of Science	4,951	271	803	901	880.28	983	1302
Science – G6	Biological Sciences	721	490	871	960	952.79	1045	1397
Science – G6	Physical Sciences	1,072	370	732	833	824.28	913	1273
Science – G6	Earth and Space Sciences	2,284	429	789	882	871.38	962	1272
Science – G7	The Nature of Science	9,400	200	781	912	878.87	998	1453
Science – G7	Biological Sciences	8,199	200	742	879	859.22	982	1457
Science – G7	Physical Sciences	1,918	200	687	817	810.44	939	1232
Science – G7	Earth and Space Sciences	3,188	200	681	803	797.13	915	1229
Science – G8	The Nature of Science	9,407	200	759	909	876.26	1003	1475
Science – G8	Biological Sciences	2,036	235	665	836	820.31	973	1316
Science – G8	Physical Sciences	5,195	200	759	890	868.95	988	1376
Science – G8	Earth and Space Sciences	1,941	200	671	813	803.18	934	1244
Science – HS	The Nature of Science	278	377	685	849	819.11	961	1192
Science – HS	Biological Sciences	200	316	630	754	771.57	909	1272
Science – HS	Physical Sciences	728	200	709	852	831.57	958	1364
Science – HS	Earth and Space Sciences	348	351	689	854	821.83	963	1167
Biology	Basic Biological Principles/ Chemical Basis for Life	12,168	400	886	988	981.03	1086	1797
Biology	Bioenergetics/ Homeostasis and Transport	7,490	400	901	1006	1008.29	1119	1736
Biology	Cell Growth and Reproduction/ Genetics	4,023	400	886	1017	1008.58	1124	1763
Biology	Theory of Evolution/ Ecology	4,701	400	843	980	954.17	1082	1582

Table 15–18b (continued). Summary Statistics for Scale Score Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Chemistry	Properties and Classification of Matter	164	438	761	916	880.41	1011	1227
Chemistry	Atomic Structure and The Periodic Table	772	627	938	1020	1016.63	1097	1374
Chemistry	The Mole and Chemical Bonding	48	694	857	910	912.56	1003	1184
Chemistry	Chemical Relationships and Reactions	51	619	841	896	900.39	965	1181
Writing – G3	Quality of Writing: Focus and Organization	189	272	638	762	753.46	876	1135
Writing – G3	Quality of Writing: Content and Style	39	335	648	743	744.59	863	1126
Writing – G3	Quality of Writing: Editing	0	0	0	0	0.00	0	0
Writing – G3	Conventions: Punctuation, Capitalization, and Spelling	1,349	200	479	554	582.24	679	1087
Writing – G3	Conventions: Grammar and Sentence Formation	1,308	200	396	514	542.00	681	1110
Writing – G4	Quality of Writing: Focus and Organization	233	200	601	821	763.58	913	1116
Writing – G4	Quality of Writing: Content and Style	71	305	599	729	731.56	866	1092
Writing – G4	Quality of Writing: Editing	36	293	486	780	709.92	885	1079
Writing – G4	Conventions: Punctuation, Capitalization, and Spelling	1,358	200	530	619	646.66	767	1201
Writing – G4	Conventions: Grammar and Sentence Formation	1,416	200	460	654	638.01	804	1277

Table 15–18b (continued). Summary Statistics for Scale Score Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Writing – G5	Quality of Writing: Focus and Organization	384	264	747	886	848.11	987	1300
Writing – G5	Quality of Writing: Content and Style	38	445	703	843	807.63	910	1180
Writing – G5	Quality of Writing: Editing	71	318	744	873	850.07	970	1170
Writing – G5	Conventions: Punctuation, Capitalization, and Spelling	1,364	200	580	668	697.95	814	1165
Writing – G5	Conventions: Grammar and Sentence Formation	2,010	200	588	740	718.56	870	1183
Writing – G6	Quality of Writing: Focus and Organization	528	359	839	952	925.41	1030	1395
Writing – G6	Quality of Writing: Content and Style	59	387	762	855	848.90	968	1193
Writing – G6	Quality of Writing: Editing	42	455	864	911	913.19	982	1135
Writing – G6	Conventions: Punctuation, Capitalization, and Spelling	1,783	338	665	804	804.50	941	1474
Writing – G6	Conventions: Grammar and Sentence Formation	1,789	200	687	839	810.48	950	1361
Writing – G7	Quality of Writing: Focus and Organization	424	317	813	945	909.23	1027	1330
Writing – G7	Quality of Writing: Content and Style	241	224	795	949	921.93	1050	1445
Writing – G7	Quality of Writing: Editing	49	447	804	940	909.45	1047	1183
Writing – G7	Conventions: Punctuation, Capitalization, and Spelling	2,119	200	651	799	807.36	957	1441

Table 15–18b (continued). Summary Statistics for Scale Score Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Writing – G7	Conventions: Grammar and Sentence Formation	2,550	213	688	845	819.80	969	1341
Writing – G8	Quality of Writing: Focus and Organization	676	200	808	963	919.54	1057	1359
Writing – G8	Quality of Writing: Content and Style	530	246	687	823	831.76	968	1297
Writing – G8	Quality of Writing: Editing	249	465	745	920	892.97	1021	1337
Writing – G8	Conventions: Punctuation, Capitalization, and Spelling	1,942	200	677	836	832.33	977	1557
Writing – G8	Conventions: Grammar and Sentence Formation	2,238	200	699	879	845.29	1000	1383
English Composition	Quality of Writing: Focus and Organization	378	460	858	995	953.92	1075	1307
English Composition	Quality of Writing: Content and Style	130	201	688	870	848.48	1028	1192
English Composition	Quality of Writing: Editing	141	375	737	902	862.66	1005	1190
English Composition	Conventions: Punctuation, Capitalization, and Spelling	599	364	705	878	855.42	1009	1589
English Composition	Conventions: Grammar and Sentence Formation	819	200	684	860	824.68	971	1260

Tables 15–19a and 15–19b show the summary statistics for the conditional standard errors of measurement (CSEMs) in the scale score metric. The final column in the table shows the theoretical minimum CSEM that is possible for a test length equal to the mean number of points. This is the standard error if the student's ability is known and there are sufficient items in the operational pool to administer where the item's difficulty is equal to the known ability and the test constraints are met.

Table 15–19a. Summary Statistics for Conditional Standard Errors Based on Full CDT

CDT	*N*	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Math – G3	32,556	35	37	38	38.17	39	56	36.31
Math – G4	33,809	34	37	38	38.12	39	52	36.31
Math – G5	40,610	34	37	38	38.06	38	74	36.67
Math – G6	47,976	34	37	37	37.28	38	127	34.64
Math – G7	53,789	34	37	37	37.25	38	75	34.64
Math – G8	45,784	34	37	37	37.37	38	59	34.64
Math – HS	642	35	37	37	37.83	38	62	33.99
Algebra I	76,958	34	37	37	37.75	38	127	34.31
Geometry	8,595	35	37	37	37.60	38	130	34.31
Algebra II	8,299	35	37	37	37.77	38	90	34.31
Reading – G3	29,868	38	41	42	43.15	44	104	39.32
Reading – G4	32,775	38	41	42	42.61	44	85	39.32
Reading – G5	37,823	37	41	42	42.39	43	76	39.66
Reading – G6	40,440	37	40	41	41.83	43	104	37.84
Reading – G7	41,229	38	40	41	42.08	43	86	37.84
Reading – G8	40,378	38	41	42	42.35	43	76	37.84
Literature	103,750	37	41	42	42.67	44	104	38.17
Science – G3	3,319	37	40	40	40.58	41	55	38.63
Science – G4	19,845	37	40	40	40.44	41	56	39.01
Science – G5	7,859	37	40	40	40.35	41	56	39.01
Science – G6	18,008	36	39	39	39.54	40	64	36.85
Science – G7	28,568	37	39	39	39.60	40	134	36.85
Science – G8	45,976	36	39	39	39.61	40	58	36.85
Science – HS	2,207	37	39	39	39.98	40	53	36.50
Biology	87,485	37	39	39	39.80	40	72	36.50
Chemistry	6,302	37	39	39	40.43	41	68	36.50
Writing – G3	3,669	36	39	39	39.56	40	59	37.60
Writing – G4	4,424	36	39	39	39.32	40	56	37.60
Writing – G5	5,602	36	39	39	39.24	40	64	37.60
Writing – G6	8,801	36	38	38	38.32	39	59	35.87
Writing – G7	11,917	36	38	38	38.36	39	58	35.87
Writing – G8	11,553	36	38	38	38.48	39	53	35.55
English Composition	6,228	36	38	38	38.90	39	69	35.55

Table 15–19b. Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Math – G3	Numbers and Operations	8,613	65	66	67	68.33	68	232	65.47
Math – G3	Algebraic Concepts	3,305	65	67	68	68.69	69	133	63.51
Math – G3	Geometry	1,423	65	67	68	68.81	69	133	63.51
Math – G3	Measurement, Data, and Probability	1,178	65	67	68	68.96	69	133	63.51
Math – G4	Numbers and Operations	8,580	65	66	67	68.07	68	231	65.47
Math – G4	Algebraic Concepts	3,546	65	66	67	68.24	68	231	65.47
Math – G4	Geometry	737	65	67	68	68.63	68	231	63.51
Math – G4	Measurement, Data, and Probability	1,157	65	67	68	69.28	69	231	65.47
Math – G5	Numbers and Operations	11,455	65	66	67	67.92	68	231	65.47
Math – G5	Algebraic Concepts	2,388	65	66	67	67.97	68	232	65.47
Math – G5	Geometry	894	65	67	68	68.60	68	233	65.47
Math – G5	Measurement, Data, and Probability	1,172	65	66	67	68.47	68	133	65.47
Math – G6	Numbers and Operations	9,710	63	65	65	65.91	66	230	62.45
Math – G6	Algebraic Concepts	5,750	63	65	65	65.92	66	133	62.45
Math – G6	Geometry	1,616	63	65	65	66.01	66	129	62.45
Math – G6	Measurement, Data, and Probability	1,491	63	65	65	66.53	66	131	62.45
Math – G7	Numbers and Operations	8,478	63	65	65	66.06	66	132	62.45
Math – G7	Algebraic Concepts	8,825	63	65	65	66.47	66	233	62.45
Math – G7	Geometry	2,535	63	65	65	66.17	66	233	60.59
Math – G7	Measurement, Data, and Probability	1,522	63	65	65	67.29	66	131	60.59

Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Math – G8	Numbers and Operations	7,628	63	65	65	66.26	66	231	62.45
Math – G8	Algebraic Concepts	7,668	63	65	65	67.08	66	234	60.59
Math – G8	Geometry	2,381	63	65	65	66.45	66	232	60.59
Math – G8	Measurement, Data, and Probability	1,310	63	65	65	67.23	66	133	60.59
Math – HS	Numbers and Operations	179	63	65	65	66.82	66	100	60.59
Math – HS	Algebraic Concepts	66	63	65	66	70.07	71	101	60.59
Math – HS	Geometry	0	0	0	0	0.00	0	0	#N/A
Math – HS	Measurement, Data, and Probability	0	0	0	0	0.00	0	0	#N/A
Algebra I	Operations with Real Numbers and Expressions	5,547	63	65	65	66.75	66	131	60.59
Algebra I	Linear Equations & Inequalities	8,643	63	65	65	67.14	66	231	62.45
Algebra I	Functions & Coordinate Geometry	5,336	63	65	65	66.50	66	230	62.45
Algebra I	Data Analysis	2,999	63	65	65	67.07	66	233	60.59
Geometry	Geometric Properties	128	63	65	65	67.14	66	100	62.45
Geometry	Congruence, Similarity, and Proofs	123	63	65	66	69.10	70	133	60.59
Geometry	Coordinate Geometry and Right Triangles	255	63	65	66	68.12	67	231	60.59
Geometry	Measurement	341	63	65	65	66.48	66	97	62.45
Algebra II	Operations with Complex Numbers	583	63	65	66	76.35	72	231	60.59
Algebra II	Non-Linear Expressions & Equations	325	63	65	65	65.97	66	100	62.45
Algebra II	Functions	357	63	65	65	66.23	66	130	60.59
Algebra II	Data Analysis	171	63	65	65	66.10	66	101	62.45

Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Reading – G3	Informational Text	3,770	48	53	55	55.89	58	109	50.62
Reading – G3	Literature Text	4,710	48	53	55	56.22	58	148	49.91
Reading – G4	Informational Text	3,041	47	53	55	55.89	58	150	50.62
Reading – G4	Literature Text	5,220	47	52	54	55.36	57	108	49.91
Reading – G5	Informational Text	5,671	47	52	54	55.17	57	107	50.62
Reading – G5	Literature Text	4,511	47	52	54	55.07	57	148	50.62
Reading – G6	Informational Text	7,066	47	52	53	54.55	56	108	48.29
Reading – G6	Literature Text	5,111	47	51	52	53.72	55	146	48.29
Reading – G7	Informational Text	6,539	48	52	54	55.14	57	150	48.99
Reading – G7	Literature Text	6,075	47	51	53	54.30	56	107	48.29
Reading – G8	Informational Text	6,003	48	53	54	55.60	57	107	48.99
Reading – G8	Literature Text	5,927	48	52	54	55.09	57	110	48.29
Literature	Informational Text	11,914	48	53	55	55.98	57	150	49.73
Literature	Literature Text	12,332	47	53	54	55.72	57	262	48.99
Science – G3	The Nature of Science	2	69	69	84	83.97	0	98	67.56
Science – G3	Biological Sciences	71	69	70	72	71.88	73	78	69.64
Science – G3	Physical Sciences	2	69	69	75	75.07	0	81	67.56
Science – G3	Earth and Space Sciences	2	70	70	71	71.02	0	72	69.64
Science – G4	The Nature of Science	1,612	69	71	72	75.04	73	246	67.56
Science – G4	Biological Sciences	1,458	68	71	72	74.20	73	246	67.56
Science – G4	Physical Sciences	1,415	66	71	72	73.99	73	246	67.56
Science – G4	Earth and Space Sciences	1,373	69	71	72	74.15	73	145	67.56

Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Science – G5	The Nature of Science	1,335	64	71	72	72.20	73	138	69.64
Science – G5	Biological Sciences	125	69	70	72	72.30	73	102	69.64
Science – G5	Physical Sciences	415	69	70	72	71.74	72	106	69.64
Science – G5	Earth and Space Sciences	61	69	71	72	71.98	73	79	69.64
Science – G6	The Nature of Science	4,951	64	69	69	69.69	70	139	66.44
Science – G6	Biological Sciences	721	66	69	69	69.53	70	100	66.44
Science – G6	Physical Sciences	1,072	67	69	69	70.10	70	142	66.44
Science – G6	Earth and Space Sciences	2,284	66	69	69	69.84	70	105	66.44
Science – G7	The Nature of Science	9,400	66	69	69	70.32	70	245	66.44
Science – G7	Biological Sciences	8,199	65	69	69	70.87	70	245	66.44
Science – G7	Physical Sciences	1,918	66	69	70	72.60	71	248	64.45
Science – G7	Earth and Space Sciences	3,188	67	69	70	71.59	70	245	64.45
Science – G8	The Nature of Science	9,407	66	69	69	70.63	70	246	66.44
Science – G8	Biological Sciences	2,036	65	69	70	71.74	70	146	64.45
Science – G8	Physical Sciences	5,195	67	69	69	71.25	70	261	66.44
Science – G8	Earth and Space Sciences	1,941	66	69	70	72.07	70	248	64.45

Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Science – HS	The Nature of Science	278	67	69	70	71.51	70	103	64.45
Science – HS	Biological Sciences	200	67	69	70	73.71	74	138	64.45
Science – HS	Physical Sciences	728	67	69	70	72.36	71	149	64.45
Science – HS	Earth and Space Sciences	348	67	69	70	72.57	72	138	64.45
Biology	Basic Biological Principles/ Chemical Basis for Life	12,168	64	69	69	70.54	70	250	66.44
Biology	Bioenergetics/ Homeostasis and Transport	7,490	65	69	69	70.99	70	246	66.44
Biology	Cell Growth and Reproduction/ Genetics	4,023	65	69	70	72.08	70	245	64.45
Biology	Theory of Evolution/ Ecology	4,701	67	69	69	71.16	70	245	66.44
Chemistry	Properties and Classification of Matter	164	67	69	70	72.51	72	110	64.45
Chemistry	Atomic Structure and The Periodic Table	772	67	69	69	72.02	71	139	66.44
Chemistry	The Mole and Chemical Bonding	48	67	69	70	74.50	74	103	64.45
Chemistry	Chemical Relationships and Reactions	51	67	69	71	75.22	77	138	64.45

Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Writing – G3	Quality of Writing: Focus and Organization	189	69	71	72	72.25	73	89	69.72
Writing – G3	Quality of Writing: Content and Style	39	69	71	72	72.52	73	89	69.72
Writing – G3	Quality of Writing: Editing	0	0	0	0	0.00	0	0	#N/A
Writing – G3	Conventions: Punctuation, Capitalization, and Spelling	1,349	69	71	72	76.18	76	245	67.64
Writing – G3	Conventions: Grammar and Sentence Formation	1,308	69	71	72	75.88	74	246	67.64
Writing – G4	Quality of Writing: Focus and Organization	233	69	71	72	73.32	73	139	69.72
Writing – G4	Quality of Writing: Content and Style	71	69	71	71	73.18	73	105	69.72
Writing – G4	Quality of Writing: Editing	36	69	70	72	74.16	73	101	67.64
Writing – G4	Conventions: Punctuation, Capitalization, and Spelling	1,358	69	71	72	75.58	76	245	69.72
Writing – G4	Conventions: Grammar and Sentence Formation	1,416	69	71	72	74.35	73	246	69.72

Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Writing – G5	Quality of Writing: Focus and Organization	384	69	71	72	72.76	73	138	69.72
Writing – G5	Quality of Writing: Content and Style	38	69	70	71	72.16	72	83	69.72
Writing – G5	Quality of Writing: Editing	71	69	71	72	73.21	73	103	69.72
Writing – G5	Conventions: Punctuation, Capitalization, and Spelling	1,364	69	71	72	73.86	73	246	69.72
Writing – G5	Conventions: Grammar and Sentence Formation	2,010	69	71	72	72.74	73	140	69.72
Writing – G6	Quality of Writing: Focus and Organization	528	67	69	70	70.62	70	138	66.51
Writing – G6	Quality of Writing: Content and Style	59	68	69	70	72.10	70	138	66.51
Writing – G6	Quality of Writing: Editing	42	68	69	69	69.81	70	89	66.51
Writing – G6	Conventions: Punctuation, Capitalization, and Spelling	1,783	67	69	70	71.87	71	139	64.52
Writing – G6	Conventions: Grammar and Sentence Formation	1,789	67	69	70	70.75	70	140	66.51

Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Writing – G7	Quality of Writing: Focus and Organization	424	67	69	70	70.86	70	138	66.51
Writing – G7	Quality of Writing: Content and Style	241	67	69	70	73.55	71	246	66.51
Writing – G7	Quality of Writing: Editing	49	68	69	69	70.66	70	102	64.52
Writing – G7	Conventions: Punctuation, Capitalization, and Spelling	2,119	67	69	70	72.64	71	245	64.52
Writing – G7	Conventions: Grammar and Sentence Formation	2,550	67	69	70	71.22	70	142	66.51
Writing – G8	Quality of Writing: Focus and Organization	676	67	69	70	71.67	70	247	66.51
Writing – G8	Quality of Writing: Content and Style	530	67	69	70	74.07	72	246	64.52
Writing – G8	Quality of Writing: Editing	249	67	69	70	70.79	70	102	66.51
Writing – G8	Conventions: Punctuation, Capitalization, and Spelling	1,942	67	69	70	72.80	71	247	64.52
Writing – G8	Conventions: Grammar and Sentence Formation	2,238	67	69	70	71.35	70	246	66.51

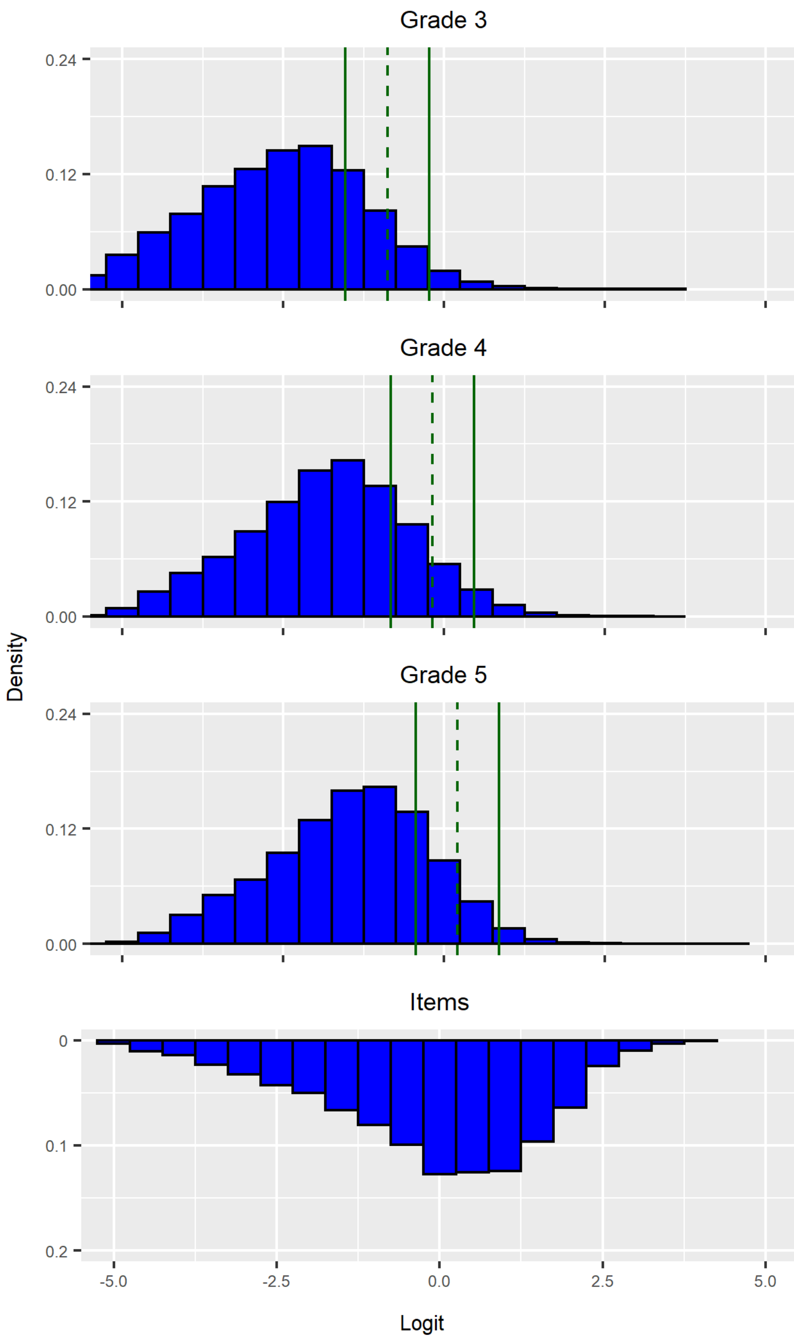
Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Eng. Comp.	Quality of Writing: Focus and Organization	378	67	69	70	70.58	70	105	66.51
Eng. Comp.	Quality of Writing: Content and Style	130	67	69	70	74.45	73	245	64.52
Eng. Comp.	Quality of Writing: Editing	141	67	69	70	72.06	70	138	66.51
Eng. Comp.	Conventions: Punctuation, Capitalization, and Spelling	599	67	69	70	73.03	72	140	64.52
Eng. Comp.	Conventions: Grammar and Sentence Formation	819	67	69	70	72.64	71	248	64.52

Values in the “Minimum” column that are less than the “Theoretical Minimum” are due to students taking more than the mean number of points. Recall that calculation of “Theoretical Minimum” is based on the mean number of points.

Figures 15–1 through 15–8 show the scale score distributions for the total test for the content areas mathematics, reading, science, and writing. Tests with multiple benchmark cuts are broken down to match the grade level of the cuts while tests that are course-specific are not broken down. The benchmark cuts in place during the 2021–2022 school year are shown in green[2]. The bottom plot in each figure represents the distribution of items in the content area pools.

Figure 15–1. Scale Score Distribution – Math Grades 3–5 Total Scores



[2] For details on benchmark cuts, see Chapter Ten and Chapter Nineteen.

Figure 15–2. Scale Score Distribution – Math Total Scores

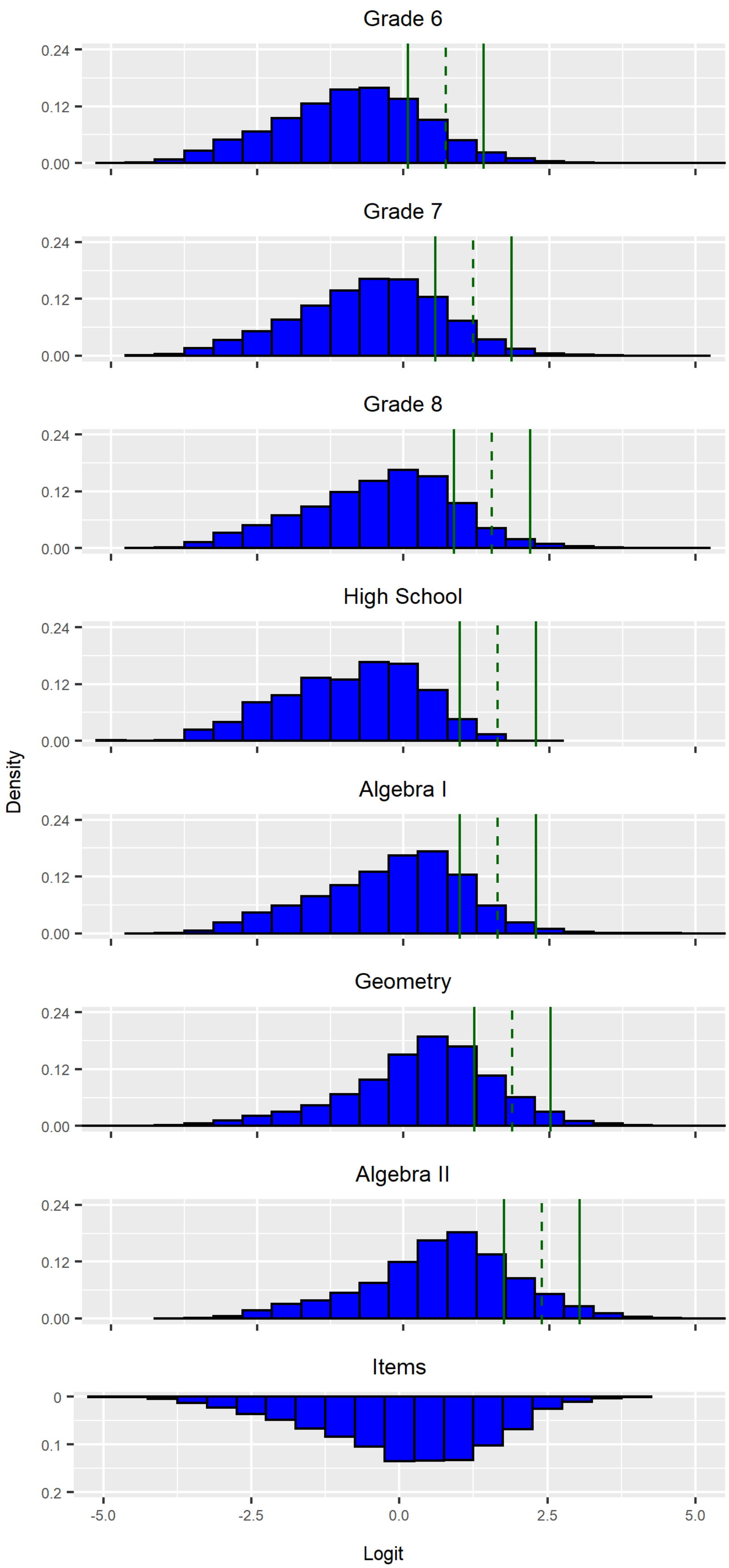


Figure 15–3. Scale Score Distribution – Reading Grades 3–5 Total Scores

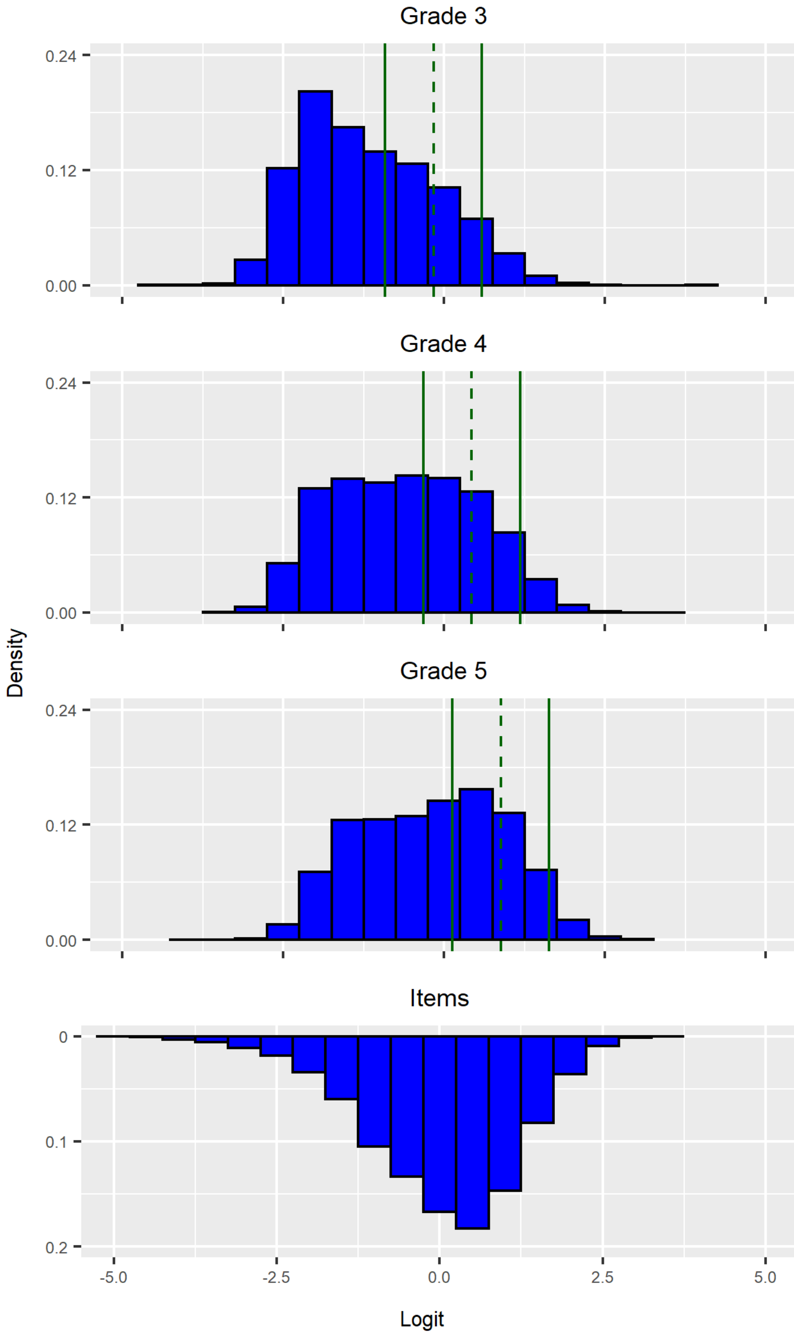


Figure 15–4. Scale Score Distribution – Reading/Literature Total Scores

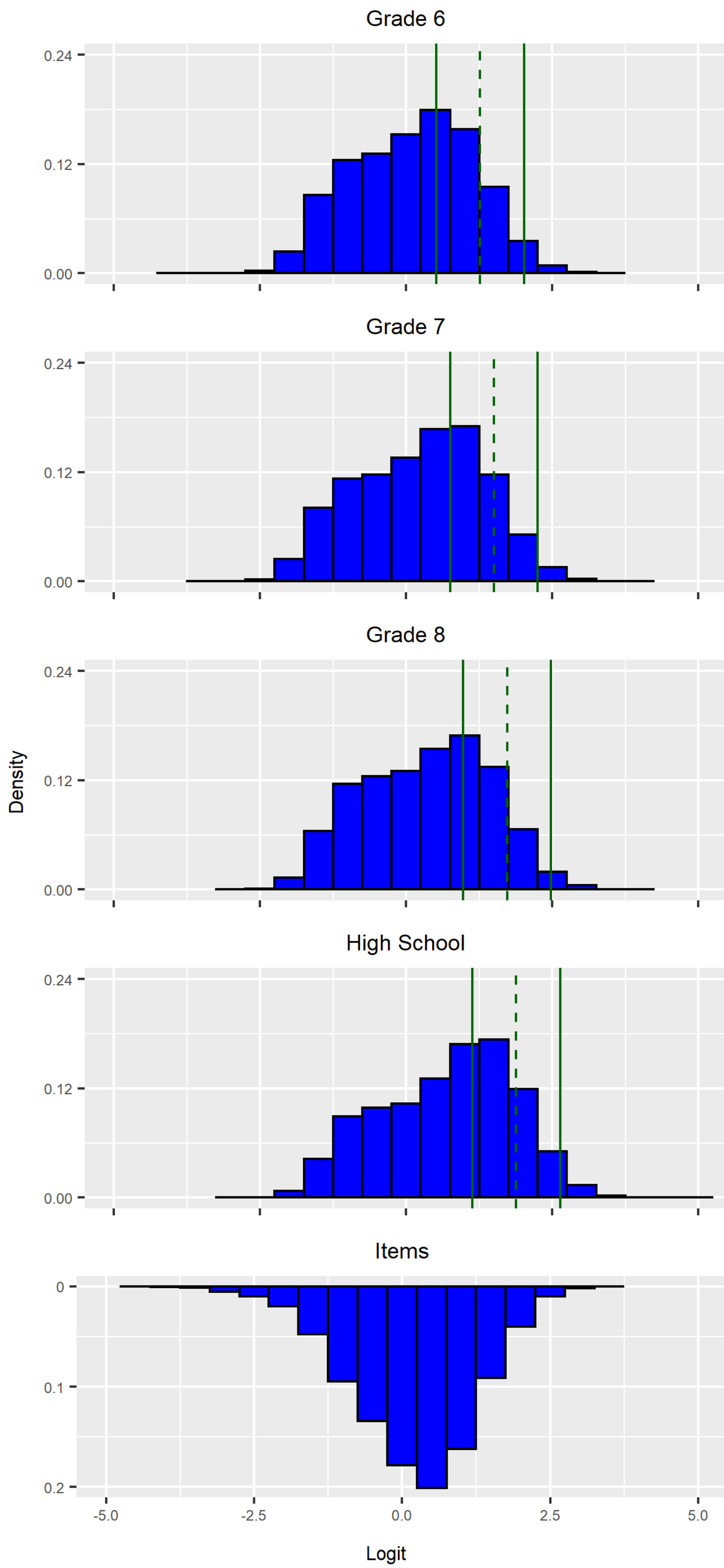


Figure 15–5. Scale Score Distribution – Science Grades 3–5 Total Scores

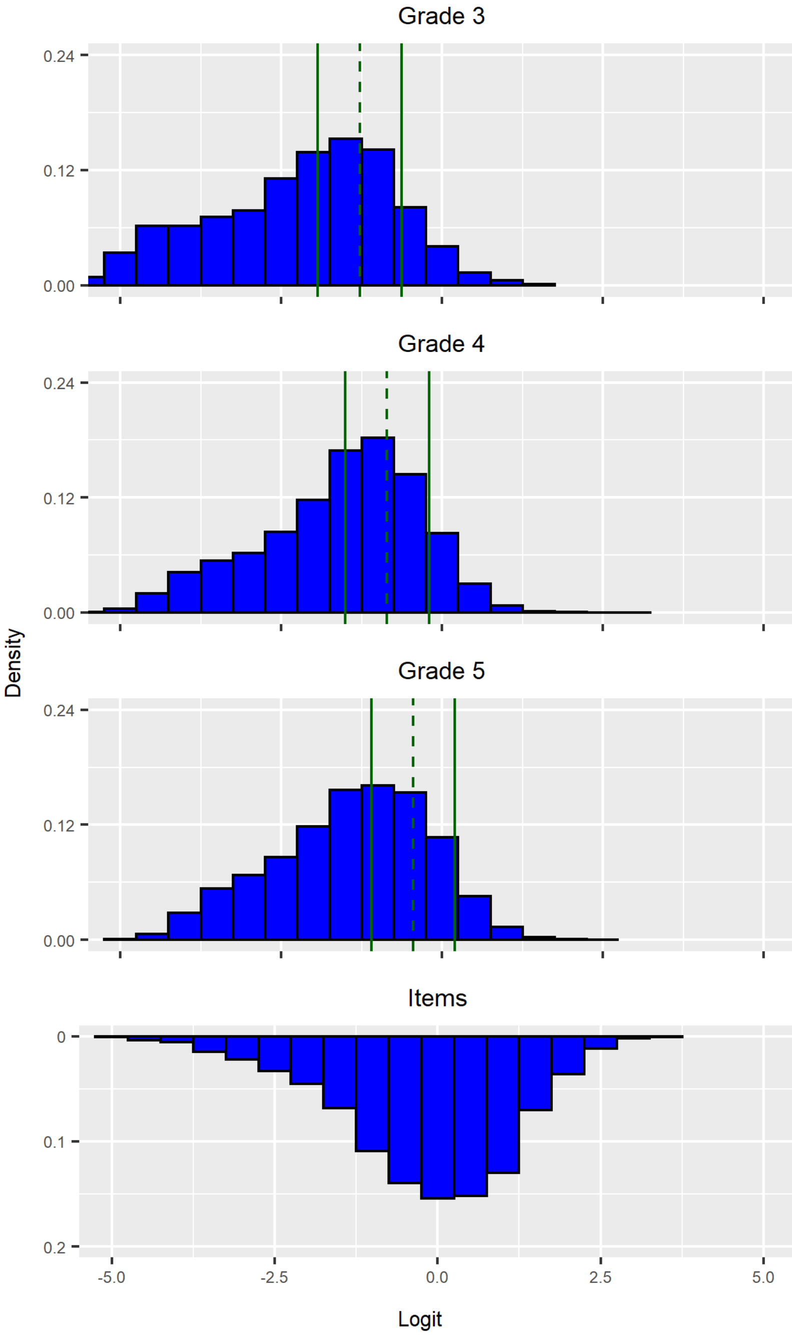


Figure 15–6. Scale Score Distribution – Science Total Scores

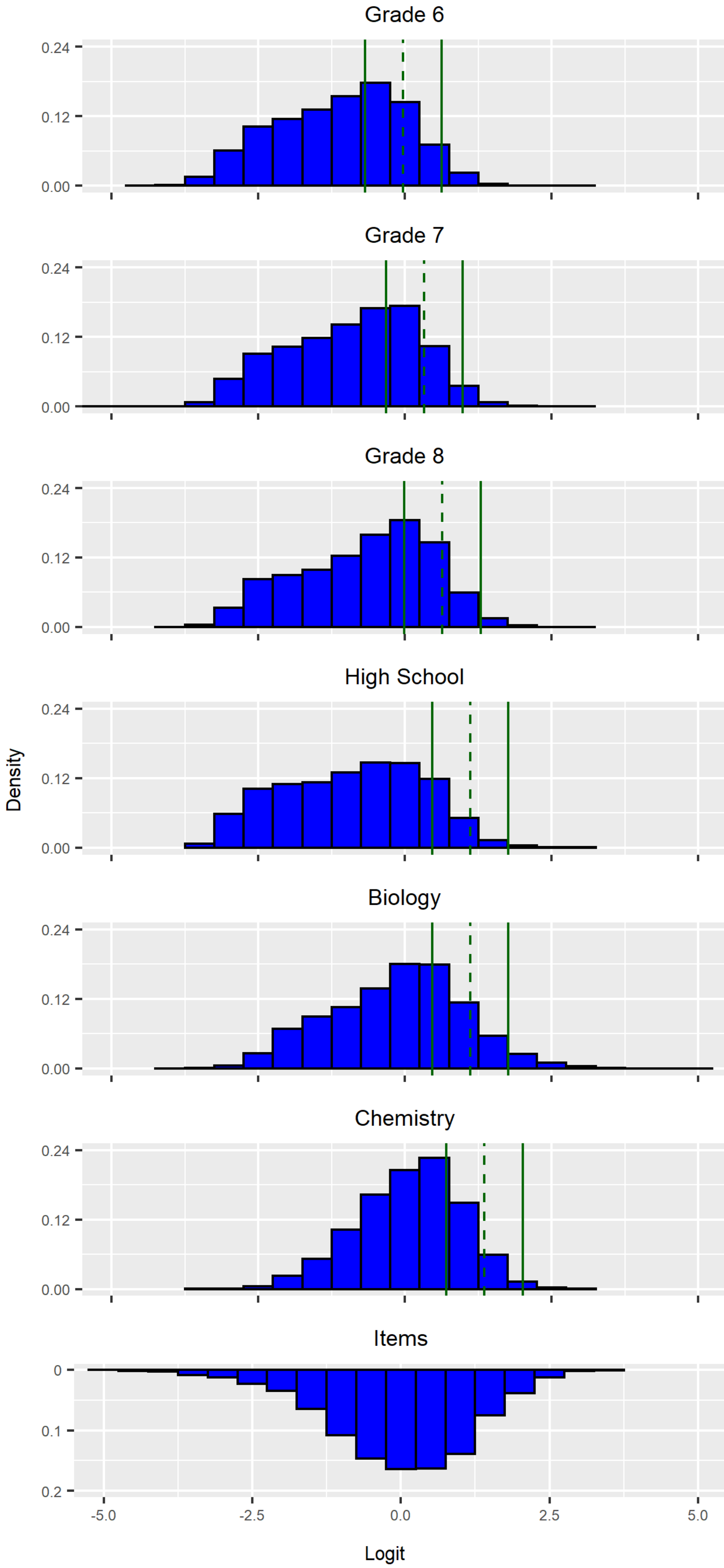


Figure 15–7. Scale Score Distribution – Writing Grades 3–5 Total Scores

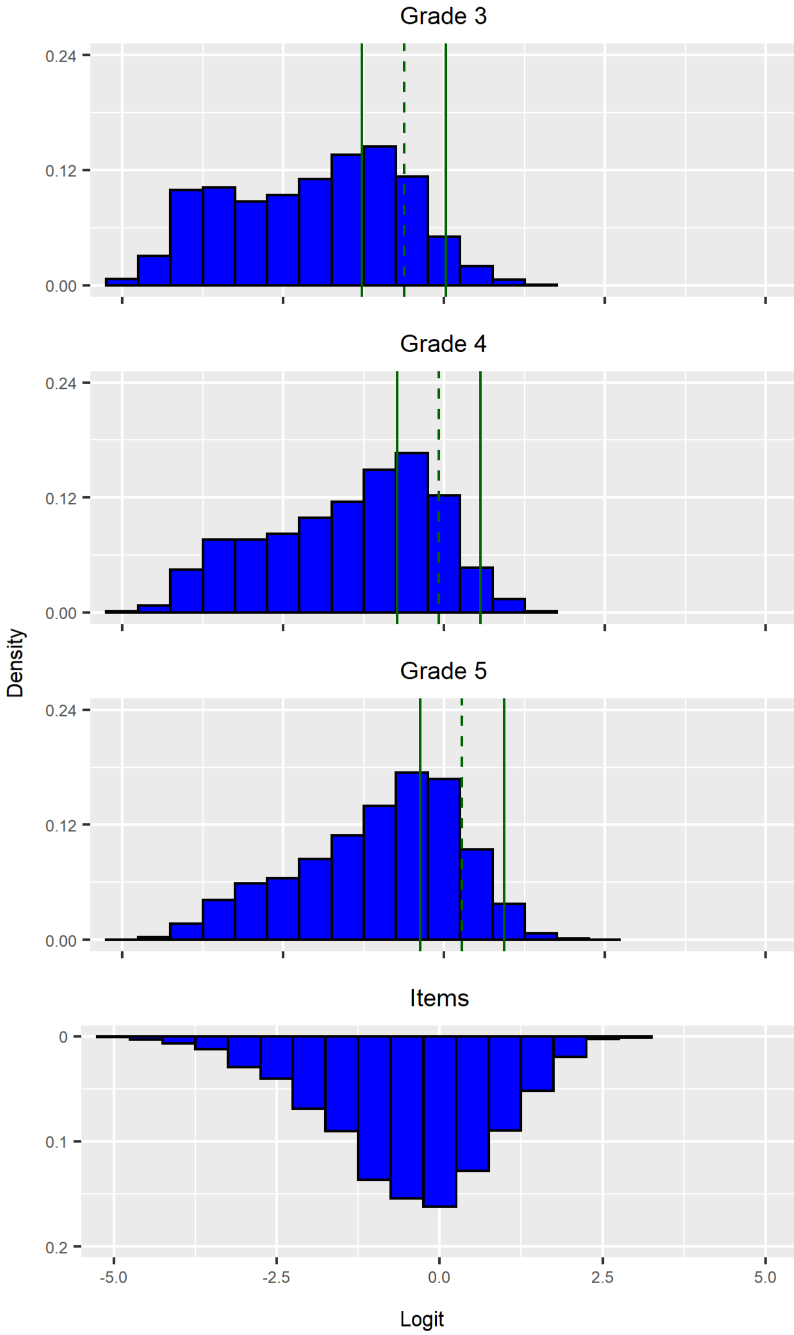
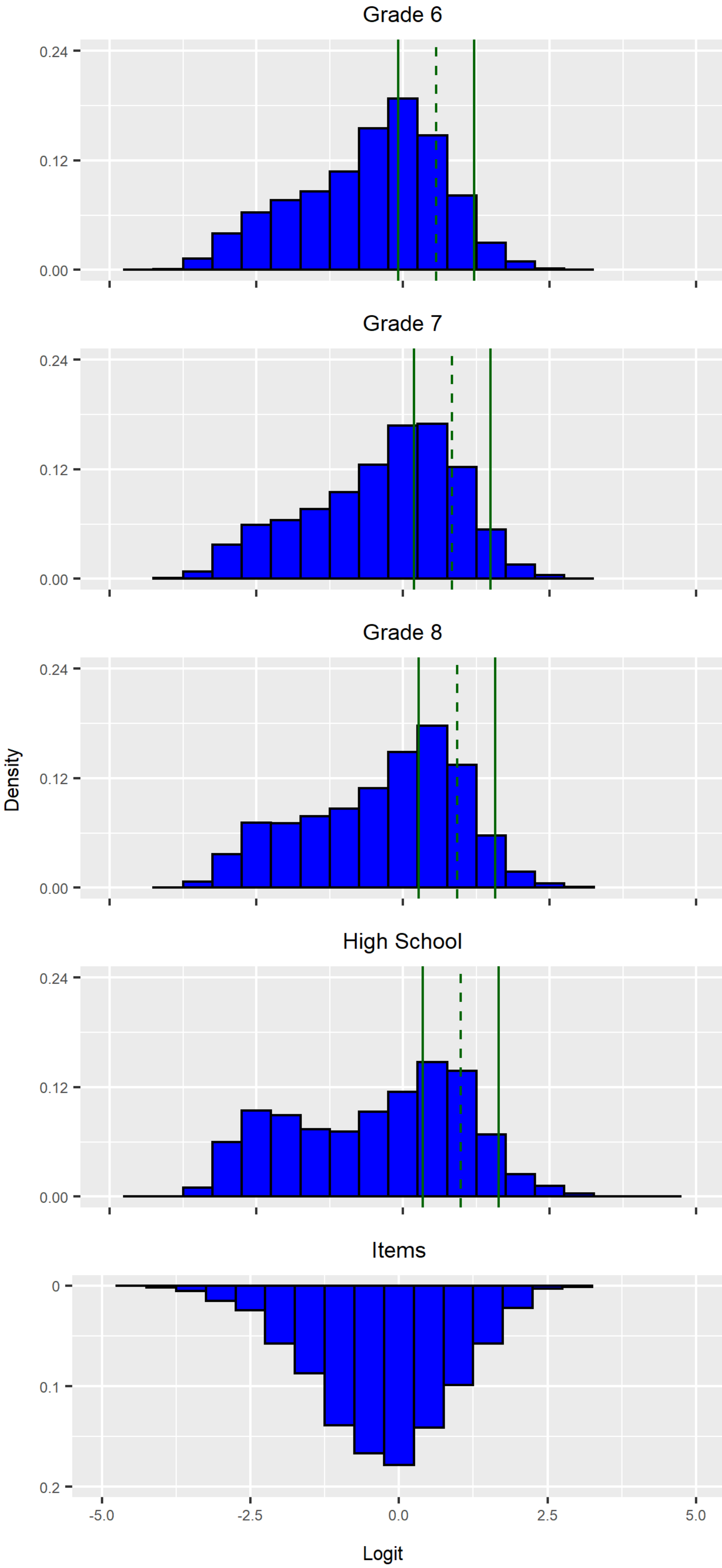


Figure 15–8. Scale Score Distribution – Writing/English Composition Total Scores



SUMMARY STATISTICS – SCALE SCORES AND CONDITIONAL STANDARD ERRORS FOR DIAGNOSTIC CATEGORY SUB-SCORES FROM FULL CDT

Earlier in this chapter, tables 15–18b and 15–19b show summary statistics for the diagnostic category scale scores and conditional standard errors from diagnostic category CDT tests. In this section, tables Table 15–20 and Table 15–21 show summary statistics for diagnostic categories from full CDT tests. Diagnostic category sub-scores from full CDTs are presented here because N-counts are significantly higher. For example, there are only 171 tests of Algebra II Data Analysis while there are 8,299 tests of Algebra II which includes the sub-score Data Analysis. To be consistent with previous tables, tests with multiple benchmark cuts are broken down to match the grade level of the cuts, while tests that are course-specific are not broken down.

Table 15–20. Summary Statistics for Diagnostic Category Scale Score Based on Full CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Math – G3	Numbers and Operations	32,556	200	560	688	680.33	799	1653
Math – G3	Algebraic Concepts	32,556	200	578	722	711.49	842	1603
Math – G3	Geometry	32,556	200	571	687	676.75	783	1570
Math – G3	Measurement, Data, and Probability	32,556	200	563	708	700.17	835	1478
Math – G4	Numbers and Operations	33,809	200	665	789	779.94	896	1663
Math – G4	Algebraic Concepts	33,809	200	683	808	800.07	928	1578
Math – G4	Geometry	33,809	200	659	753	760.77	861	1458
Math – G4	Measurement, Data, and Probability	33,809	200	663	802	787.67	916	1498
Math – G5	Numbers and Operations	40,610	200	716	850	839.26	966	1663
Math – G5	Algebraic Concepts	40,610	200	718	838	824.37	944	1743
Math – G5	Geometry	40,610	200	709	808	813.53	929	1716
Math – G5	Measurement, Data, and Probability	40,610	200	729	839	828.31	938	1709
Math – G6	Numbers and Operations	47,976	200	791	917	913.25	1048	1715
Math – G6	Algebraic Concepts	47,976	200	773	912	896.77	1025	1790
Math – G6	Geometry	47,976	211	803	916	905.57	1013	1769
Math – G6	Measurement, Data, and Probability	47,976	200	782	893	896.28	1014	1762
Math – G7	Numbers and Operations	53,789	200	832	961	948.92	1082	1715
Math – G7	Algebraic Concepts	53,789	200	838	964	945.62	1069	1807
Math – G7	Geometry	53,789	200	842	948	941.39	1051	1776
Math – G7	Measurement, Data, and Probability	53,789	218	809	928	927.55	1052	1795
Math – G8	Numbers and Operations	45,784	200	838	982	959.03	1109	1736
Math – G8	Algebraic Concepts	45,784	200	854	988	971.42	1088	1826

Table 15–20 (continued). Summary Statistics for Diagnostic Category Scale Score Based on Full CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Math – G8	Geometry	45,784	221	857	972	965.25	1077	1675
Math – G8	Measurement, Data, and Probability	45,784	209	831	967	952.85	1082	1817
Math – HS	Numbers and Operations	642	242	777	905	894.62	1036	1284
Math – HS	Algebraic Concepts	642	397	801	936	916.73	1044	1323
Math – HS	Geometry	642	200	803	912	907.20	1024	1310
Math – HS	Measurement, Data, and Probability	642	243	763	907	888.83	1018	1289
Algebra I	Operations with Real Numbers and Expressions	76,958	400	859	1014	977.53	1122	1816
Algebra I	Linear Equations & Inequalities	76,958	412	885	1013	1001.13	1114	1790
Algebra I	Functions & Coordinate Geometry	76,958	400	889	1014	1000.07	1113	1832
Algebra I	Data Analysis	76,958	400	857	995	972.04	1099	1851
Geometry	Geometric Properties	8,595	400	946	1078	1049.57	1169	1790
Geometry	Congruence, Similarity, and Proofs	8,595	400	975	1079	1065.40	1176	1794
Geometry	Coordinate Geometry and Right Triangles	8,595	400	960	1078	1059.76	1176	1794
Geometry	Measurement	8,595	400	931	1070	1045.25	1170	1824
Algebra II	Operations with Complex Numbers	8,299	544	1013	1114	1143.87	1248	1847
Algebra II	Non-Linear Expressions & Equations	8,299	400	980	1109	1080.18	1208	1905
Algebra II	Functions	8,299	400	989	1115	1095.21	1214	1865
Algebra II	Data Analysis	8,299	400	964	1091	1058.80	1183	1853
Reading – G3	Key Ideas – Lit text	29,868	200	576	694	704.56	836	1471
Reading – G3	Key Ideas – Info text	29,868	200	567	690	697.05	833	1483
Reading – G3	Craft & Structure – Lit text	29,868	200	608	710	718.14	829	1502
Reading – G3	Craft & Structure – Info text	29,868	200	587	694	702.67	820	1506
Reading – G3	Vocabulary	29,868	200	551	696	692.30	834	1485
Reading – G4	Key Ideas – Lit text	32,775	200	637	778	778.71	922	1539
Reading – G4	Key Ideas – Info text	32,775	200	641	779	775.35	913	1523

Table 15–20 (continued). Summary Statistics for Diagnostic Category Scale Score Based on Full CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Reading – G4	Craft & Structure – Lit text	32,775	200	680	800	803.28	929	1524
Reading – G4	Craft & Structure – Info text	32,775	200	653	781	783.85	921	1573
Reading – G4	Vocabulary	32,775	200	639	792	776.64	915	1487
Reading – G5	Key Ideas – Lit text	37,823	200	707	856	844.94	987	1579
Reading – G5	Key Ideas – Info text	37,823	200	713	846	838.86	971	1558
Reading – G5	Craft & Structure – Lit text	37,823	200	740	857	858.81	984	1588
Reading – G5	Craft & Structure – Info text	37,823	200	688	844	832.04	982	1588
Reading – G5	Vocabulary	37,823	200	699	857	837.14	977	1542
Reading – G6	Key Ideas – Lit text	40,440	200	770	902	894.16	1017	1601
Reading – G6	Key Ideas – Info text	40,440	200	767	898	888.90	1014	1594
Reading – G6	Craft & Structure – Lit text	40,440	243	774	898	889.63	1008	1588
Reading – G6	Craft & Structure – Info text	40,440	200	748	895	877.60	1015	1597
Reading – G6	Vocabulary	40,440	200	751	898	879.04	1010	1590
Reading – G7	Key Ideas – Lit text	41,229	200	778	914	906.01	1036	1629
Reading – G7	Key Ideas – Info text	41,229	200	784	925	911.67	1045	1627
Reading – G7	Craft & Structure – Lit text	41,229	243	786	916	906.83	1032	1620
Reading – G7	Craft & Structure – Info text	41,229	200	757	918	894.13	1038	1641
Reading – G7	Vocabulary	41,229	200	764	920	897.02	1038	1597
Reading – G8	Key Ideas – Lit text	40,378	215	784	925	918.13	1056	1627
Reading – G8	Key Ideas – Info text	40,378	200	792	939	921.10	1059	1624
Reading – G8	Craft & Structure – Lit text	40,378	238	810	935	928.49	1052	1656
Reading – G8	Craft & Structure – Info text	40,378	218	781	931	913.10	1052	1669
Reading – G8	Vocabulary	40,378	200	776	935	913.06	1056	1630
Literature	Key Ideas – Lit text	103,750	200	827	979	963.25	1102	1669
Literature	Key Ideas – Info text	103,750	200	849	999	974.92	1111	1640
Literature	Craft & Structure – Lit text	103,750	248	848	988	973.51	1101	1663
Literature	Craft & Structure – Info text	103,750	206	837	992	969.40	1107	1656
Literature	Vocabulary	103,750	200	836	995	971.84	1113	1647

Table 15–20 (continued). Summary Statistics for Diagnostic Category Scale Score Based on Full CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Science – G3	The Nature of Science	3,319	200	512	676	653.01	799	1241
Science – G3	Biological Sciences	3,319	200	524	679	658.49	800	1311
Science – G3	Physical Sciences	3,319	200	524	694	666.65	818	1170
Science – G3	Earth and Space Sciences	3,319	200	529	684	661.32	800	1287
Science – G4	The Nature of Science	19,845	200	617	753	733.11	864	1544
Science – G4	Biological Sciences	19,845	200	624	757	737.61	869	1386
Science – G4	Physical Sciences	19,845	200	641	772	743.56	865	1435
Science – G4	Earth and Space Sciences	19,845	200	619	758	739.05	860	1274
Science – G5	The Nature of Science	7,859	200	635	767	753.25	880	1392
Science – G5	Biological Sciences	7,859	200	634	770	755.74	891	1465
Science – G5	Physical Sciences	7,859	200	663	788	770.39	891	1409
Science – G5	Earth and Space Sciences	7,859	200	650	776	762.99	884	1283
Science – G6	The Nature of Science	18,008	200	663	814	796.71	932	1387
Science – G6	Biological Sciences	18,008	200	676	817	801.67	927	1527
Science – G6	Physical Sciences	18,008	200	702	823	812.64	925	1505
Science – G6	Earth and Space Sciences	18,008	200	701	820	808.58	926	1323
Science – G7	The Nature of Science	28,568	200	691	845	823.06	960	1497
Science – G7	Biological Sciences	28,568	200	696	845	827.77	960	1441
Science – G7	Physical Sciences	28,568	200	734	856	843.92	959	1396
Science – G7	Earth and Space Sciences	28,568	200	720	844	830.78	945	1525
Science – G8	The Nature of Science	45,976	200	722	884	855.88	993	1468
Science – G8	Biological Sciences	45,976	200	728	880	857.72	992	1472
Science – G8	Physical Sciences	45,976	200	757	886	870.44	989	1472
Science – G8	Earth and Space Sciences	45,976	200	744	873	853.41	972	1457
Science – HS	The Nature of Science	2,207	200	662	835	820.45	974	1378
Science – HS	Biological Sciences	2,207	200	689	845	828.69	967	1456
Science – HS	Physical Sciences	2,207	222	734	865	853.02	975	1359
Science – HS	Earth and Space Sciences	2,207	274	689	835	820.80	957	1540

Table 15–20 (continued). Summary Statistics for Diagnostic Category Scale Score Based on Full CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Biology	Basic Biological Principles/Chemical Basis for Life	87,485	400	818	942	927.26	1048	1790
Biology	Bioenergetics/ Homeostasis and Transport	87,485	400	839	941	942.07	1042	1736
Biology	Cell Growth and Reproduction/ Genetics	87,485	400	838	951	942.81	1047	1774
Biology	Theory of Evolution/ Ecology	87,485	400	783	942	912.66	1050	1743
Chemistry	Properties and Classification of Matter	6,302	400	797	962	916.87	1059	1564
Chemistry	Atomic Structure and The Periodic Table	6,302	491	914	995	993.65	1075	1463
Chemistry	The Mole and Chemical Bonding	6,302	407	891	981	973.07	1063	1403
Chemistry	Chemical Relationships and Reactions	6,302	414	873	963	959.83	1052	1563
Writing – G3	Quality of Writing: Focus and Organization	3,669	200	517	687	675.17	832	1302
Writing – G3	Quality of Writing: Content and Style	3,669	200	529	705	673.36	825	1288
Writing – G3	Quality of Writing: Editing	3,669	200	545	697	682.44	815	1333
Writing – G3	Conventions: Punctuation, Capitalization, and Spelling	3,669	200	553	677	681.10	821	1319
Writing – G3	Conventions: Grammar and Sentence Formation	3,669	200	521	688	675.34	841	1360
Writing – G4	Quality of Writing: Focus and Organization	4,424	200	597	763	738.98	895	1344
Writing – G4	Quality of Writing: Content and Style	4,424	200	614	769	745.98	884	1353
Writing – G4	Quality of Writing: Editing	4,424	200	611	763	746.12	891	1310

Table 15–20 (continued). Summary Statistics for Diagnostic Category Scale Score Based on Full CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Writing – G4	Conventions: Punctuation, Capitalization, and Spelling	4,424	200	624	775	761.24	898	1299
Writing – G4	Conventions: Grammar and Sentence Formation	4,424	200	637	790	757.03	900	1295
Writing – G5	Quality of Writing: Focus and Organization	5,602	200	661	824	796.97	944	1532
Writing – G5	Quality of Writing: Content and Style	5,602	200	689	830	810.45	939	1394
Writing – G5	Quality of Writing: Editing	5,602	200	693	831	807.95	942	1448
Writing – G5	Conventions: Punctuation, Capitalization, and Spelling	5,602	200	688	835	818.69	956	1590
Writing – G5	Conventions: Grammar and Sentence Formation	5,602	200	719	847	819.47	950	1311
Writing – G6	Quality of Writing: Focus and Organization	8,801	200	729	893	864.54	1009	1570
Writing – G6	Quality of Writing: Content and Style	8,801	217	744	894	879.63	1015	1577
Writing – G6	Quality of Writing: Editing	8,801	200	750	893	868.50	1004	1612
Writing – G6	Conventions: Punctuation, Capitalization, and Spelling	8,801	214	769	905	884.78	1005	1626
Writing – G6	Conventions: Grammar and Sentence Formation	8,801	200	765	897	868.20	993	1430
Writing – G7	Quality of Writing: Focus and Organization	11,917	200	759	929	893.54	1043	1562
Writing – G7	Quality of Writing: Content and Style	11,917	237	766	928	907.07	1051	1632
Writing – G7	Quality of Writing: Editing	11,917	200	775	925	897.65	1042	1490

Table 15–20 (continued). Summary Statistics for Diagnostic Category Scale Score Based on Full CDT

CDT	Diagnostic Category	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Writing – G7	Conventions: Punctuation, Capitalization, and Spelling	11,917	230	793	934	914.39	1048	1704
Writing – G7	Conventions: Grammar and Sentence Formation	11,917	200	785	921	889.74	1020	1520
Writing – G8	Quality of Writing: Focus and Organization	11,553	200	748	930	893.99	1057	1473
Writing – G8	Quality of Writing: Content and Style	11,553	254	747	931	903.50	1059	1624
Writing – G8	Quality of Writing: Editing	11,553	200	761	929	897.90	1042	1491
Writing – G8	Conventions: Punctuation, Capitalization, and Spelling	11,553	202	778	935	911.39	1055	1720
Writing – G8	Conventions: Grammar and Sentence Formation	11,553	200	784	931	898.43	1035	1686
English Composition	Quality of Writing: Focus and Organization	6,228	200	694	919	883.00	1071	1596
English Composition	Quality of Writing: Content and Style	6,228	247	704	911	885.90	1063	1461
English Composition	Quality of Writing: Editing	6,228	200	708	913	879.14	1052	1706
English Composition	Conventions: Punctuation, Capitalization, and Spelling	6,228	216	726	928	901.45	1069	1719
English Composition	Conventions: Grammar and Sentence Formation	6,228	200	728	924	879.69	1043	1518

Table 15–21 shows the summary statistics for the conditional standard errors of measurement (CSEMs) for diagnostic categories in the scale score metric based on full CDT. The final column in the table shows the theoretical minimum CSEM that is possible for a test length equal to the mean number of points. Minimum values in the table that are less than the theoretical minimum are due to students taking more than the mean number of points.

Table 15–21. Summary Statistics for Diagnostic Category Conditional Standard Errors Based on Full CDT

CDT	Diagnostic Category	*N*	Min	Q1	Median	Mean	Q3	Max	Theoretical Minimum
Math – G3	Numbers and Operations	32,556	71	74	76	76.22	77	233	72.63
Math – G3	Algebraic Concepts	32,556	71	74	76	76.16	77	234	72.63
Math – G3	Geometry	32,556	72	75	76	76.07	77	233	72.63
Math – G3	Measurement, Data, and Probability	32,556	72	74	76	76.34	77	233	72.63
Math – G4	Numbers and Operations	33,809	72	74	76	76.02	77	232	72.63
Math – G4	Algebraic Concepts	33,809	72	74	76	75.82	77	232	72.63
Math – G4	Geometry	33,809	71	74	76	75.78	77	238	72.63
Math – G4	Measurement, Data, and Probability	33,809	72	74	76	76.03	77	233	72.63
Math – G5	Numbers and Operations	40,610	72	74	76	75.95	77	231	72.63
Math – G5	Algebraic Concepts	40,610	72	74	75	75.73	77	232	72.63
Math – G5	Geometry	40,610	72	74	76	75.76	77	247	72.63
Math – G5	Measurement, Data, and Probability	40,610	72	74	76	75.89	77	235	72.63
Math – G6	Numbers and Operations	47,976	69	73	74	74.11	74	232	69.28
Math – G6	Algebraic Concepts	47,976	69	73	74	74.48	74	238	69.28
Math – G6	Geometry	47,976	69	73	74	74.01	74	232	69.28
Math – G6	Measurement, Data, and Probability	47,976	69	73	74	74.35	74	233	69.28
Math – G7	Numbers and Operations	53,789	69	73	74	74.29	74	233	69.28
Math – G7	Algebraic Concepts	53,789	69	73	74	74.44	74	235	69.28
Math – G7	Geometry	53,789	69	73	74	73.88	74	234	69.28
Math – G7	Measurement, Data, and Probability	53,789	69	73	74	74.47	74	233	69.28
Math – G8	Numbers and Operations	45,784	69	73	74	74.36	74	233	69.28
Math – G8	Algebraic Concepts	45,784	69	73	74	74.84	74	237	69.28
Math – G8	Geometry	45,784	69	73	74	74.34	74	234	69.28
Math – G8	Measurement, Data, and Probability	45,784	69	73	74	74.80	74	233	69.28
Math – HS	Numbers and Operations	642	69	73	74	75.08	75	231	69.28
Math – HS	Algebraic Concepts	642	70	73	74	75.78	75	137	66.76
Math – HS	Geometry	642	69	73	74	75.60	75	238	69.28
Math – HS	Measurement, Data, and Probability	642	70	73	74	76.00	75	232	69.28

Table 15–21 (continued). Summary Statistics for Diagnostic Category Conditional Standard Errors Based on Full CDT

CDT	Diagnostic Category	*N*	Min	Q1	Median	Mean	Q3	Max	Theoretical Minimum
Algebra I	Operations with Real Numbers and Expressions	76,958	69	73	74	74.79	74	233	69.28
Algebra I	Linear Equations & Inequalities	76,958	69	73	74	75.95	75	232	69.28
Algebra I	Functions & Coordinate Geometry	76,958	69	73	74	75.36	75	238	69.28
Algebra I	Data Analysis	76,958	69	73	74	75.39	75	235	69.28
Geometry	Geometric Properties	8,595	69	73	74	74.43	74	242	69.28
Geometry	Congruence, Similarity, and Proofs	8,595	69	73	74	75.36	75	252	69.28
Geometry	Coordinate Geometry and Right Triangles	8,595	69	73	74	75.07	74	231	69.28
Geometry	Measurement	8,595	70	73	74	74.55	74	234	69.28
Algebra II	Operations with Complex Numbers	8,299	69	73	74	78.67	75	232	69.28
Algebra II	Non-Linear Expressions & Equations	8,299	70	73	74	75.09	74	236	69.28
Algebra II	Functions	8,299	69	73	74	75.14	74	243	69.28
Algebra II	Data Analysis	8,299	69	73	74	75.28	75	234	69.28
Reading – G3	Key Ideas – Lit text	29,868	74	89	95	99.18	101	275	86.44
Reading – G3	Key Ideas – Info text	29,868	74	91	97	101.44	103	276	90.29
Reading – G3	Craft & Structure – Lit text	29,868	75	94	99	103.89	106	280	90.29
Reading – G3	Craft & Structure – Info text	29,868	69	90	96	101.46	102	280	86.44
Reading – G3	Vocabulary	29,868	74	93	98	102.88	103	277	90.29
Reading – G4	Key Ideas – Lit text	32,775	71	89	95	98.38	101	280	86.44
Reading – G4	Key Ideas – Info text	32,775	74	90	95	99.43	101	276	90.29
Reading – G4	Craft & Structure – Lit text	32,775	71	92	98	101.31	103	282	86.44
Reading – G4	Craft & Structure – Info text	32,775	72	89	94	98.73	101	279	86.44
Reading – G4	Vocabulary	32,775	75	93	98	102.23	103	280	90.29
Reading – G5	Key Ideas – Lit text	37,823	72	90	95	98.67	101	286	86.44
Reading – G5	Key Ideas – Info text	37,823	73	90	95	97.99	101	279	86.44

Table 15–21 (continued). Summary Statistics for Diagnostic Category Conditional Standard Errors Based on Full CDT

CDT	Diagnostic Category	*N*	Min	Q1	Median	Mean	Q3	Max	Theoretical Minimum
Reading – G5	Craft & Structure – Lit text	37,823	72	89	95	97.86	101	276	86.44
Reading – G5	Craft & Structure – Info text	37,823	70	90	95	99.08	101	279	86.44
Reading – G5	Vocabulary	37,823	76	94	98	102.55	103	275	90.29
Reading – G6	Key Ideas – Lit text	40,440	71	88	93	97.22	100	273	82.46
Reading – G6	Key Ideas – Info text	40,440	73	89	94	97.65	100	284	82.46
Reading – G6	Craft & Structure – Lit text	40,440	72	89	94	97.08	100	278	86.13
Reading – G6	Craft & Structure – Info text	40,440	72	88	93	97.23	100	273	82.46
Reading – G6	Vocabulary	40,440	78	94	97	101.61	102	284	86.13
Reading – G7	Key Ideas – Lit text	41,229	72	87	92	96.84	99	275	82.46
Reading – G7	Key Ideas – Info text	41,229	73	89	94	97.89	100	271	82.46
Reading – G7	Craft & Structure – Lit text	41,229	74	89	94	97.90	100	275	86.13
Reading – G7	Craft & Structure – Info text	41,229	74	89	94	98.43	101	271	86.13
Reading – G7	Vocabulary	41,229	80	94	98	102.57	103	280	86.13
Reading – G8	Key Ideas – Lit text	40,378	73	88	94	98.18	100	273	82.46
Reading – G8	Key Ideas – Info text	40,378	74	89	94	98.65	100	271	86.13
Reading – G8	Craft & Structure – Lit text	40,378	74	89	94	98.49	100	279	86.13
Reading – G8	Craft & Structure – Info text	40,378	75	89	94	98.58	100	273	86.13
Reading – G8	Vocabulary	40,378	81	95	99	103.32	104	279	86.13
Literature	Key Ideas – Lit text	103,750	73	89	94	99.71	101	275	82.46
Literature	Key Ideas – Info text	103,750	75	90	94	99.60	101	285	86.13
Literature	Craft & Structure – Lit text	103,750	79	90	94	98.55	100	276	86.13
Literature	Craft & Structure – Info text	103,750	76	89	94	99.00	100	275	86.13
Literature	Vocabulary	103,750	81	96	100	106.99	105	279	86.13
Science – G3	The Nature of Science	3,319	76	79	81	81.60	82	259	77.26
Science – G3	Biological Sciences	3,319	75	79	80	81.07	82	246	77.26
Science – G3	Physical Sciences	3,319	76	79	81	81.47	82	247	77.26
Science – G3	Earth and Space Sciences	3,319	72	79	80	81.23	82	247	77.26
Science – G4	The Nature of Science	19,845	72	79	80	81.01	82	265	77.26

Table 15–21 (continued). Summary Statistics for Diagnostic Category Conditional Standard Errors Based on Full CDT

CDT	Diagnostic Category	*N*	Min	Q1	Median	Mean	Q3	Max	Theoretical Minimum
Science – G4	Biological Sciences	19,845	74	79	80	80.90	82	247	77.26
Science – G4	Physical Sciences	19,845	73	79	80	80.70	82	248	77.26
Science – G4	Earth and Space Sciences	19,845	73	79	80	80.74	82	249	77.26
Science – G5	The Nature of Science	7,859	72	79	80	81.33	82	271	77.26
Science – G5	Biological Sciences	7,859	73	79	80	80.94	82	248	77.26
Science – G5	Physical Sciences	7,859	73	79	80	80.88	81	248	77.26
Science – G5	Earth and Space Sciences	7,859	76	79	80	80.76	81	248	77.26
Science – G6	The Nature of Science	18,008	70	77	78	79.40	79	278	73.70
Science – G6	Biological Sciences	18,008	71	77	78	79.62	79	253	73.70
Science – G6	Physical Sciences	18,008	72	77	78	79.98	79	249	73.70
Science – G6	Earth and Space Sciences	18,008	73	77	78	79.54	79	250	73.70
Science – G7	The Nature of Science	28,568	72	77	78	79.55	79	246	73.70
Science – G7	Biological Sciences	28,568	71	77	78	79.84	79	246	73.70
Science – G7	Physical Sciences	28,568	73	77	78	79.60	79	249	73.70
Science – G7	Earth and Space Sciences	28,568	72	77	78	79.43	79	246	73.70
Science – G8	The Nature of Science	45,976	73	77	78	79.53	79	246	73.70
Science – G8	Biological Sciences	45,976	71	77	78	79.78	79	251	73.70
Science – G8	Physical Sciences	45,976	74	77	78	79.51	79	249	73.70
Science – G8	Earth and Space Sciences	45,976	73	77	78	79.46	79	250	73.70
Science – HS	The Nature of Science	2,207	74	77	79	80.54	79	246	73.70
Science – HS	Biological Sciences	2,207	74	77	79	81.52	79	246	73.70
Science – HS	Physical Sciences	2,207	74	77	79	80.37	79	247	73.70
Science – HS	Earth and Space Sciences	2,207	74	77	79	80.42	79	145	73.70

Table 15–21 (continued). Summary Statistics for Diagnostic Category Conditional Standard Errors Based on Full CDT

CDT	Diagnostic Category	*N*	Min	Q1	Median	Mean	Q3	Max	Theoretical Minimum
Biology	Basic Biological Principles/Chemical Basis for Life	87,485	70	77	78	79.87	79	254	73.70
Biology	Bioenergetics/ Homeostasis and Transport	87,485	70	77	78	80.07	79	246	73.70
Biology	Cell Growth and Reproduction/ Genetics	87,485	72	77	78	80.53	79	247	73.70
Biology	Theory of Evolution/ Ecology	87,485	72	77	78	80.15	79	247	73.70
Chemistry	Properties and Classification of Matter	6,302	74	77	78	80.17	79	253	73.70
Chemistry	Atomic Structure and The Periodic Table	6,302	74	77	79	81.38	79	246	73.70
Chemistry	The Mole and Chemical Bonding	6,302	74	77	79	80.74	79	246	73.70
Chemistry	Chemical Relationships and Reactions	6,302	74	77	79	81.66	80	246	73.70
Writing – G3	Quality of Writing: Focus and Organization	3,669	82	86	87	89.33	89	249	84.09
Writing – G3	Quality of Writing: Content and Style	3,669	82	86	87	90.25	89	256	84.09
Writing – G3	Quality of Writing: Editing	3,669	82	86	87	90.13	89	247	84.09
Writing – G3	Conventions: Punctuation, Capitalization, and Spelling	3,669	82	86	87	91.24	89	246	84.09
Writing – G3	Conventions: Grammar and Sentence Formation	3,669	82	86	87	89.75	89	247	84.09
Writing – G4	Quality of Writing: Focus and Organization	4,424	82	86	87	89.38	89	250	84.09
Writing – G4	Quality of Writing: Content and Style	4,424	82	86	87	89.41	89	250	84.09
Writing – G4	Quality of Writing: Editing	4,424	82	86	87	88.92	89	247	84.09

Table 15–21 (continued). Summary Statistics for Diagnostic Category Conditional Standard Errors Based on Full CDT

CDT	Diagnostic Category	*N*	Min	Q1	Median	Mean	Q3	Max	Theoretical Minimum
Writing – G4	Conventions: Punctuation, Capitalization, and Spelling	4,424	82	86	87	89.63	89	247	84.09
Writing – G4	Conventions: Grammar and Sentence Formation	4,424	82	86	87	88.54	89	248	84.09
Writing – G5	Quality of Writing: Focus and Organization	5,602	82	86	87	88.74	89	248	84.09
Writing – G5	Quality of Writing: Content and Style	5,602	82	86	87	88.82	89	251	84.09
Writing – G5	Quality of Writing: Editing	5,602	82	86	87	88.25	88	247	84.09
Writing – G5	Conventions: Punctuation, Capitalization, and Spelling	5,602	82	86	87	88.87	89	248	84.09
Writing – G5	Conventions: Grammar and Sentence Formation	5,602	82	86	87	88.00	88	248	84.09
Writing – G6	Quality of Writing: Focus and Organization	8,801	81	84	85	87.46	86	249	80.21
Writing – G6	Quality of Writing: Content and Style	8,801	81	84	85	88.81	86	248	80.21
Writing – G6	Quality of Writing: Editing	8,801	80	83	85	86.18	86	249	80.21
Writing – G6	Conventions: Punctuation, Capitalization, and Spelling	8,801	81	83	85	86.88	86	248	80.21
Writing – G6	Conventions: Grammar and Sentence Formation	8,801	80	83	85	86.04	86	250	80.21
Writing – G7	Quality of Writing: Focus and Organization	11,917	81	84	85	87.83	86	249	80.21
Writing – G7	Quality of Writing: Content and Style	11,917	81	84	85	88.23	86	247	80.21
Writing – G7	Quality of Writing: Editing	11,917	81	84	85	86.38	86	251	80.21

Table 15–21 (continued). Summary Statistics for Diagnostic Category Conditional Standard Errors Based on Full CDT

CDT	Diagnostic Category	*N*	Min	Q1	Median	Mean	Q3	Max	Theoretical Minimum
Writing – G7	Conventions: Punctuation, Capitalization, and Spelling	11,917	81	84	85	86.93	86	248	80.21
Writing – G7	Conventions: Grammar and Sentence Formation	11,917	81	83	85	86.21	86	251	80.21
Writing – G8	Quality of Writing: Focus and Organization	11,553	80	84	85	87.85	86	250	80.21
Writing – G8	Quality of Writing: Content and Style	11,553	81	84	85	88.63	86	248	80.21
Writing – G8	Quality of Writing: Editing	11,553	81	84	85	86.88	86	247	80.21
Writing – G8	Conventions: Punctuation, Capitalization, and Spelling	11,553	81	84	85	87.44	86	249	80.21
Writing – G8	Conventions: Grammar and Sentence Formation	11,553	81	83	85	86.78	86	251	80.21
Eng. Comp.	Quality of Writing: Focus and Organization	6,228	81	84	85	89.34	87	251	80.21
Eng. Comp.	Quality of Writing: Content and Style	6,228	81	84	85	89.87	90	248	80.21
Eng. Comp.	Quality of Writing: Editing	6,228	81	84	85	88.78	86	250	80.21
Eng. Comp.	Conventions: Punctuation, Capitalization, and Spelling	6,228	81	84	85	89.28	86	250	80.21
Eng. Comp.	Conventions: Grammar and Sentence Formation	6,228	81	84	85	88.28	86	252	80.21

DIAGNOSTIC CATEGORY SCORE DIFFERENCES

As described in Chapter Fourteen, the CDT reports that are available to teachers display scale scores and probable score ranges for each diagnostic category. The probable score range is the scale score ± one standard error. Probable score range differences—ranges that do not overlap—may indicate to teachers a meaningful difference between two diagnostic category scores. Tables 15–22a through 15–34a show the number of students with score range differences (non-overlapping probable score ranges) between pairs of diagnostic categories for each full[3] CDT test. For example, according to Table 15–22a, 23,443 students who took the Math Grades 3–5 assessment had score range differences between diagnostic categories 1 and 2 while 83,532 students did not. Tables 15–22b through 15–34b show the total number of score range differences. For example, 19,937 students had two pairs of diagnostic categories with score range differences, which was 18.6% of the total students who took Math Grades 3–5.

Table 15–22a. Diagnostic Category Score Range Differences – Math Grades 3–5

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	23,443	83,532	21.9%	78.1%
DC1	DC3	29,358	77,617	27.4%	72.6%
DC1	DC4	23,743	83,232	22.2%	77.8%
DC2	DC3	29,845	77,130	27.9%	72.1%
DC2	DC4	22,591	84,384	21.1%	78.9%
DC3	DC4	28,520	78,455	26.7%	73.3%

Table 15–22b. Total Number of Diagnostic Category Score Range Differences – Math Grades 3–5

Number of Score Range Differences	Number of Students	Percent of Students
0	38,219	35.7%
1	18,941	17.7%
2	19,937	18.6%
3	22,091	20.7%
4	6,534	6.1%
5	1,242	1.2%
6	11	0.0%

Table 15–23a. Diagnostic Category Score Range Differences – Math Grades 6–HS

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	37,213	110,978	25.1%	74.9%
DC1	DC3	40,739	107,452	27.5%	72.5%
DC1	DC4	39,583	108,608	26.7%	73.3%
DC2	DC3	39,584	108,607	26.7%	73.3%
DC2	DC4	39,656	108,535	26.8%	73.2%
DC3	DC4	39,682	108,509	26.8%	73.2%

[3] Score differences between diagnostic categories are based on full CDTs because scores are based on the same test event. Comparisons are not made based on diagnostic category CDTs which may be taken at very different times.

Table 15–23b. Total Number of Diagnostic Category Score Range Differences – Math Grades 6–HS

Number of Score Range Differences	Number of Students	Percent of Students
0	49,486	33.4%
1	24,684	16.7%
2	27,530	18.6%
3	32,078	21.6%
4	11,654	7.9%
5	2,691	1.8%
6	68	0.0%

Table 15–24a. Diagnostic Category Score Range Differences – Algebra I

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	25,116	51,842	32.6%	67.4%
DC1	DC3	24,559	52,399	31.9%	68.1%
DC1	DC4	24,808	52,150	32.2%	67.8%
DC2	DC3	19,117	57,841	24.8%	75.2%
DC2	DC4	22,655	54,303	29.4%	70.6%
DC3	DC4	21,507	55,451	27.9%	72.1%

Table 15–24b. Total Number of Diagnostic Category Score Range Differences – Algebra I

Number of Score Range Differences	Number of Students	Percent of Students
0	22,846	29.7%
1	11,915	15.5%
2	13,400	17.4%
3	18,479	24.0%
4	8,023	10.4%
5	2,252	2.9%
6	43	0.1%

Table 15–25a. Diagnostic Category Score Range Differences – Geometry

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	2,318	6,277	27.0%	73.0%
DC1	DC3	2,367	6,228	27.5%	72.5%
DC1	DC4	2,307	6,288	26.8%	73.2%
DC2	DC3	2,369	6,226	27.6%	72.4%
DC2	DC4	2,529	6,066	29.4%	70.6%
DC3	DC4	2,344	6,251	27.3%	72.7%

Table 15–25b. Total Number of Diagnostic Category Score Range Differences – Geometry

Number of Score Range Differences	Number of Students	Percent of Students
0	2,817	32.8%
1	1,407	16.4%
2	1,553	18.1%
3	1,791	20.8%
4	793	9.2%
5	228	2.7%
6	6	0.1%

Table 15–26a. Diagnostic Category Score Range Differences – Algebra II

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	3,103	5,196	37.4%	62.6%
DC1	DC3	3,012	5,287	36.3%	63.7%
DC1	DC4	3,683	4,616	44.4%	55.6%
DC2	DC3	2,229	6,070	26.9%	73.1%
DC2	DC4	2,418	5,881	29.1%	70.9%
DC3	DC4	2,471	5,828	29.8%	70.2%

Table 15–26b. Total Number of Diagnostic Category Score Range Differences – Algebra II

Number of Score Range Differences	Number of Students	Percent of Students
0	2,093	25.2%
1	1,101	13.3%
2	1,418	17.1%
3	2,208	26.6%
4	1,055	12.7%
5	409	4.9%
6	15	0.2%

Table 15–27a. Diagnostic Category Score Range Differences – Reading Grades 3–5

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	19,653	80,813	19.6%	80.4%
DC1	DC3	18,726	81,740	18.6%	81.4%
DC1	DC4	20,322	80,144	20.2%	79.8%
DC1	DC5	18,723	81,743	18.6%	81.4%
DC2	DC3	20,078	80,388	20.0%	80.0%
DC2	DC4	19,174	81,292	19.1%	80.9%
DC2	DC5	19,260	81,206	19.2%	80.8%
DC3	DC4	20,113	80,353	20.0%	80.0%
DC3	DC5	20,022	80,444	19.9%	80.1%
DC4	DC5	19,092	81,374	19.0%	81.0%

Table 15–27b. Total Number of Diagnostic Category Score Range Differences – Reading Grades 3–5

Number of Score Range Differences	Number of Students	Percent of Students
0	31,853	31.7%
1	15,324	15.3%
2	16,455	16.4%
3	13,401	13.3%
4	14,753	14.7%
5	4,863	4.8%
6	3,370	3.4%
7	397	0.4%
8	50	0.0%
9	0	0.0%
10	0	0.0%

Table 15–28a. Diagnostic Category Score Range Differences – Reading/Lit Grades 6–HS

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	46,087	179,710	20.4%	79.6%
DC1	DC3	42,367	183,430	18.8%	81.2%
DC1	DC4	46,549	179,248	20.6%	79.4%
DC1	DC5	46,986	178,811	20.8%	79.2%
DC2	DC3	44,680	181,117	19.8%	80.2%
DC2	DC4	42,139	183,658	18.7%	81.3%
DC2	DC5	45,609	180,188	20.2%	79.8%
DC3	DC4	45,213	180,584	20.0%	80.0%
DC3	DC5	45,918	179,879	20.3%	79.7%
DC4	DC5	44,563	181,234	19.7%	80.3%

Table 15–28b. Total Number of Diagnostic Category Score Range Differences – Reading/Lit Grades 6–HS

Number of Score Range Differences	Number of Students	Percent of Students
0	70,301	31.1%
1	34,042	15.1%
2	36,474	16.2%
3	29,776	13.2%
4	33,648	14.9%
5	11,645	5.2%
6	8,592	3.8%
7	1,133	0.5%
8	181	0.1%
9	5	0.0%
10	0	0.0%

Table 15–29a. Diagnostic Category Score Range Differences – Science Grades 3–5

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	5,602	25,421	18.1%	81.9%
DC1	DC3	5,757	25,266	18.6%	81.4%
DC1	DC4	5,978	25,045	19.3%	80.7%
DC2	DC3	5,901	25,122	19.0%	81.0%
DC2	DC4	6,007	25,016	19.4%	80.6%
DC3	DC4	5,995	25,028	19.3%	80.7%

Table 15–29b. Total Number of Diagnostic Category Score Range Differences – Science Grades 3–5

Number of Score Range Differences	Number of Students	Percent of Students
0	14,226	45.9%
1	5,701	18.4%
2	5,202	16.8%
3	4,602	14.8%
4	1,131	3.6%
5	161	0.5%
6	0	0.0%

Table 15–30a. Diagnostic Category Score Range Differences – Science Grades 6–HS

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	21,255	73,504	22.4%	77.6%
DC1	DC3	22,106	72,653	23.3%	76.7%
DC1	DC4	22,057	72,702	23.3%	76.7%
DC2	DC3	21,762	72,997	23.0%	77.0%
DC2	DC4	21,558	73,201	22.8%	77.2%
DC3	DC4	20,952	73,807	22.1%	77.9%

Table 15–30b. Total Number of Diagnostic Category Score Range Differences – Science Grades 6–HS

Number of Score Range Differences	Number of Students	Percent of Students
0	37,445	39.5%
1	16,498	17.4%
2	16,849	17.8%
3	17,443	18.4%
4	5,471	5.8%
5	1,037	1.1%
6	16	0.0%

Table 15–31a. Diagnostic Category Score Range Differences – Biology

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	20,594	66,891	23.5%	76.5%
DC1	DC3	21,136	66,349	24.2%	75.8%
DC1	DC4	21,865	65,620	25.0%	75.0%
DC2	DC3	19,587	67,898	22.4%	77.6%
DC2	DC4	24,347	63,138	27.8%	72.2%
DC3	DC4	22,819	64,666	26.1%	73.9%

Table 15–31b. Total Number of Diagnostic Category Score Range Differences – Biology

Number of Score Range Differences	Number of Students	Percent of Students
0	31,545	36.1%
1	15,098	17.3%
2	15,784	18.0%
3	17,668	20.2%
4	6,280	7.2%
5	1,102	1.3%
6	8	0.0%

Table 15–32a. Diagnostic Category Score Range Differences – Chemistry

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	2,125	4,177	33.7%	66.3%
DC1	DC3	1,905	4,397	30.2%	69.8%
DC1	DC4	1,999	4,303	31.7%	68.3%
DC2	DC3	1,260	5,042	20.0%	80.0%
DC2	DC4	1,409	4,893	22.4%	77.6%
DC3	DC4	1,300	5,002	20.6%	79.4%

Table 15–32b. Total Number of Diagnostic Category Score Range Differences – Chemistry

Number of Score Range Differences	Number of Students	Percent of Students
0	2,200	34.9%
1	1,019	16.2%
2	1,045	16.6%
3	1,396	22.2%
4	512	8.1%
5	127	2.0%
6	3	0.0%

Table 15–33a. Diagnostic Category Score Range Differences – Writing Grades 3–5

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	2,371	11,324	17.3%	82.7%
DC1	DC3	2,573	11,122	18.8%	81.2%
DC1	DC4	3,101	10,594	22.6%	77.4%
DC1	DC5	2,894	10,801	21.1%	78.9%
DC2	DC3	2,531	11,164	18.5%	81.5%
DC2	DC4	3,033	10,662	22.1%	77.9%
DC2	DC5	2,789	10,906	20.4%	79.6%
DC3	DC4	2,669	11,026	19.5%	80.5%
DC3	DC5	2,471	11,224	18.0%	82.0%
DC4	DC5	2,851	10,844	20.8%	79.2%

Table 15–33b. Total Number of Diagnostic Category Score Range Differences – Writing Grades 3–5

Number of Score Range Differences	Number of Students	Percent of Students
0	4,306	31.4%
1	2,074	15.1%
2	2,183	15.9%
3	1,731	12.6%
4	2,056	15.0%
5	749	5.5%
6	506	3.7%
7	76	0.6%
8	13	0.1%
9	1	0.0%
10	0	0.0%

Table 15–34a. Diagnostic Category Score Range Differences – Writing/Eng Comp Grades 6–HS

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	8,614	29,885	22.4%	77.6%
DC1	DC3	8,539	29,960	22.2%	77.8%
DC1	DC4	9,520	28,979	24.7%	75.3%
DC1	DC5	9,096	29,403	23.6%	76.4%
DC2	DC3	8,802	29,697	22.9%	77.1%
DC2	DC4	9,416	29,083	24.5%	75.5%
DC2	DC5	9,475	29,024	24.6%	75.4%
DC3	DC4	8,756	29,743	22.7%	77.3%
DC3	DC5	8,427	30,072	21.9%	78.1%
DC4	DC5	8,935	29,564	23.2%	76.8%

Table 15–34b. Total Number of Diagnostic Category Score Range Differences – Writing/Eng Comp Grades 6–HS

Number of Score Range Differences	Number of Students	Percent of Students
0	10,159	26.4%
1	5,241	13.6%
2	5,916	15.4%
3	5,062	13.1%
4	6,720	17.5%
5	2,660	6.9%
6	2,167	5.6%
7	456	1.2%
8	115	0.3%
9	3	0.0%
10	0	0.0%

Significant differences among diagnostic categories were tested based on t-test. Using the diagnostic category scale scores and the conditional standard errors for each student, the differences between pairs of diagnostic category scores were examined based on t-test for each student. A Bonferroni correction for multiple comparisons was performed to keep the family wise Type I error rate at 0.32. This results in the number of significant differences being smaller than the number of score range differences (non-overlapping probable score ranges) presented above. Tables 15–35a through 15–47a show the number of students who had significant differences between pairs of diagnostic categories for each assessment. Tables 15–35b through 15–47b show the total number of significant differences.

Table 15–35a. Diagnostic Category Significant Differences – Math Grades 3–5

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	2,218	104,757	2.1%	97.9%
DC1	DC3	3,940	103,035	3.7%	96.3%
DC1	DC4	2,388	104,587	2.2%	97.8%
DC2	DC3	4,015	102,960	3.8%	96.2%
DC2	DC4	2,198	104,777	2.1%	97.9%
DC3	DC4	3,562	103,413	3.3%	96.7%

Note: Z value is 1.94

Table 15–35b. Total Number of Diagnostic Category Significant Differences – Math Grades 3–5

Number of Significant Differences	Number of Students	Percent of Students
0	94,196	88.1%
1	8,478	7.9%
2	3,129	2.9%
3	1,105	1.0%
4	65	0.1%
5	2	0.0%
6	0	0.0%

Table 15–36a. Diagnostic Category Significant Differences – Math Grades 6–HS

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	5,104	143,087	3.4%	96.6%
DC1	DC3	6,180	142,011	4.2%	95.8%
DC1	DC4	5,711	142,480	3.9%	96.1%
DC2	DC3	5,421	142,770	3.7%	96.3%
DC2	DC4	5,503	142,688	3.7%	96.3%
DC3	DC4	5,686	142,505	3.8%	96.2%

Note: Z value is 1.94

Table 15–36b. Total Number of Diagnostic Category Significant Differences – Math Grades 6–HS

Number of Significant Differences	Number of Students	Percent of Students
0	126,215	85.2%
1	13,356	9.0%
2	5,891	4.0%
3	2,455	1.7%
4	268	0.2%
5	6	0.0%
6	0	0.0%

Table 15–37a. Diagnostic Category Significant Differences – Algebra I

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	5,229	71,729	6.8%	93.2%
DC1	DC3	4,862	72,096	6.3%	93.7%
DC1	DC4	5,284	71,674	6.9%	93.1%
DC2	DC3	2,197	74,761	2.9%	97.1%
DC2	DC4	3,561	73,397	4.6%	95.4%
DC3	DC4	3,263	73,695	4.2%	95.8%

Note: Z value is 1.94

Table 15–37b. Total Number of Diagnostic Category Significant Differences – Algebra I

Number of Significant Differences	Number of Students	Percent of Students
0	61,557	80.0%
1	8,756	11.4%
2	4,515	5.9%
3	1,913	2.5%
4	214	0.3%
5	3	0.0%
6	0	0.0%

Table 15–38a. Diagnostic Category Significant Differences – Geometry

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	374	8,221	4.4%	95.6%
DC1	DC3	398	8,197	4.6%	95.4%
DC1	DC4	386	8,209	4.5%	95.5%
DC2	DC3	426	8,169	5.0%	95.0%
DC2	DC4	428	8,167	5.0%	95.0%
DC3	DC4	425	8,170	4.9%	95.1%

Note: Z value is 1.94

Table 15–38b. Total Number of Diagnostic Category Significant Differences – Geometry

Number of Significant Differences	Number of Students	Percent of Students
0	7,108	82.7%
1	831	9.7%
2	397	4.6%
3	226	2.6%
4	31	0.4%
5	2	0.0%
6	0	0.0%

Table 15–39a. Diagnostic Category Significant Differences – Algebra II

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	707	7,592	8.5%	91.5%
DC1	DC3	593	7,706	7.1%	92.9%
DC1	DC4	1,108	7,191	13.4%	86.6%
DC2	DC3	353	7,946	4.3%	95.7%
DC2	DC4	485	7,814	5.8%	94.2%
DC3	DC4	438	7,861	5.3%	94.7%

Note: Z value is 1.94

Table 15–39b. Total Number of Diagnostic Category Significant Differences – Algebra II

Number of Significant Differences	Number of Students	Percent of Students
0	6,110	73.6%
1	1,146	13.8%
2	638	7.7%
3	360	4.3%
4	43	0.5%
5	2	0.0%
6	0	0.0%

Table 15–40a. Diagnostic Category Significant Differences – Reading Grades 3–5

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	242	100,224	0.2%	99.8%
DC1	DC3	207	100,259	0.2%	99.8%
DC1	DC4	283	100,183	0.3%	99.7%
DC1	DC5	204	100,262	0.2%	99.8%
DC2	DC3	284	100,182	0.3%	99.7%
DC2	DC4	251	100,215	0.2%	99.8%
DC2	DC5	234	100,232	0.2%	99.8%
DC3	DC4	238	100,228	0.2%	99.8%
DC3	DC5	327	100,139	0.3%	99.7%
DC4	DC5	291	100,175	0.3%	99.7%

Note: Z value is 2.15

Table 15–40b. Total Number of Diagnostic Category Significant Differences – Reading Grades 3–5

Number of Significant Differences	Number of Students	Percent of Students
0	98,345	97.9%
1	1,750	1.7%
2	306	0.3%
3	61	0.1%
4	4	0.0%
5	0	0.0%
6	0	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

Table 15–41a. Diagnostic Category Significant Differences – Reading/Lit Grades 6–HS

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	691	225,106	0.3%	99.7%
DC1	DC3	542	225,255	0.2%	99.8%
DC1	DC4	681	225,116	0.3%	99.7%
DC1	DC5	955	224,842	0.4%	99.6%
DC2	DC3	569	225,228	0.3%	99.7%
DC2	DC4	485	225,312	0.2%	99.8%
DC2	DC5	1,050	224,747	0.5%	99.5%
DC3	DC4	558	225,239	0.2%	99.8%
DC3	DC5	1,216	224,581	0.5%	99.5%
DC4	DC5	867	224,930	0.4%	99.6%

Note: Z value is 2.15

Table 15–41b. Total Number of Diagnostic Category Significant Differences – Reading/Lit Grades 6–HS

Number of Significant Differences	Number of Students	Percent of Students
0	219,747	97.3%
1	4,779	2.1%
2	1,027	0.5%
3	195	0.1%
4	49	0.0%
5	0	0.0%
6	0	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

Table 15–42a. Diagnostic Category Significant Differences – Science Grades 3–5

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	428	30,595	1.4%	98.6%
DC1	DC3	448	30,575	1.4%	98.6%
DC1	DC4	464	30,559	1.5%	98.5%
DC2	DC3	445	30,578	1.4%	98.6%
DC2	DC4	495	30,528	1.6%	98.4%
DC3	DC4	515	30,508	1.7%	98.3%

Note: Z value is 1.94

Table 15–42b. Total Number of Diagnostic Category Significant Differences – Science Grades 3–5

Number of Significant Differences	Number of Students	Percent of Students
0	28,994	93.5%
1	1,430	4.6%
2	439	1.4%
3	153	0.5%
4	7	0.0%
5	0	0.0%
6	0	0.0%

Table 15–43a. Diagnostic Category Significant Differences – Science Grades 6–HS

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	2,472	92,287	2.6%	97.4%
DC1	DC3	2,584	92,175	2.7%	97.3%
DC1	DC4	2,463	92,296	2.6%	97.4%
DC2	DC3	2,509	92,250	2.6%	97.4%
DC2	DC4	2,285	92,474	2.4%	97.6%
DC3	DC4	2,091	92,668	2.2%	97.8%

Note: Z value is 1.94

Table 15–43b. Total Number of Diagnostic Category Significant Differences – Science Grades 6–HS

Number of Significant Differences	Number of Students	Percent of Students
0	85,136	89.8%
1	5,983	6.3%
2	2,592	2.7%
3	956	1.0%
4	91	0.1%
5	1	0.0%
6	0	0.0%

Table 15–44a. Diagnostic Category Significant Differences – Biology

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	2,394	85,091	2.7%	97.3%
DC1	DC3	2,457	85,028	2.8%	97.2%
DC1	DC4	2,589	84,896	3.0%	97.0%
DC2	DC3	1,703	85,782	1.9%	98.1%
DC2	DC4	3,034	84,451	3.5%	96.5%
DC3	DC4	2,750	84,735	3.1%	96.9%

Note: Z value is 1.94

Table 15–44b. Total Number of Diagnostic Category Significant Differences – Biology

Number of Significant Differences	Number of Students	Percent of Students
0	76,965	88.0%
1	7,057	8.1%
2	2,605	3.0%
3	772	0.9%
4	86	0.1%
5	0	0.0%
6	0	0.0%

Table 15–45a. Diagnostic Category Significant Differences – Chemistry

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	571	5,731	9.1%	90.9%
DC1	DC3	459	5,843	7.3%	92.7%
DC1	DC4	421	5,881	6.7%	93.3%
DC2	DC3	64	6,238	1.0%	99.0%
DC2	DC4	125	6,177	2.0%	98.0%
DC3	DC4	101	6,201	1.6%	98.4%

Note: Z value is 1.94

Table 15–45b. Total Number of Diagnostic Category Significant Differences – Chemistry

Number of Significant Differences	Number of Students	Percent of Students
0	5,188	82.3%
1	638	10.1%
2	329	5.2%
3	143	2.3%
4	4	0.1%
5	0	0.0%
6	0	0.0%

Table 15–46a. Diagnostic Category Significant Differences – Writing Grades 3–5

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	71	13,624	0.5%	99.5%
DC1	DC3	90	13,605	0.7%	99.3%
DC1	DC4	140	13,555	1.0%	99.0%
DC1	DC5	120	13,575	0.9%	99.1%
DC2	DC3	73	13,622	0.5%	99.5%
DC2	DC4	116	13,579	0.8%	99.2%
DC2	DC5	116	13,579	0.8%	99.2%
DC3	DC4	82	13,613	0.6%	99.4%
DC3	DC5	83	13,612	0.6%	99.4%
DC4	DC5	86	13,609	0.6%	99.4%

Note: Z value is 2.15

Table 15–46b. Total Number of Diagnostic Category Significant Differences – Writing Grades 3–5

Number of Significant Differences	Number of Students	Percent of Students
0	13,027	95.1%
1	451	3.3%
2	148	1.1%
3	47	0.3%
4	21	0.2%
5	1	0.0%
6	0	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

Table 15–47a. Diagnostic Category Significant Differences – Writing/Eng Comp Grades 6–HS

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	390	38,109	1.0%	99.0%
DC1	DC3	459	38,040	1.2%	98.8%
DC1	DC4	547	37,952	1.4%	98.6%
DC1	DC5	534	37,965	1.4%	98.6%
DC2	DC3	394	38,105	1.0%	99.0%
DC2	DC4	495	38,004	1.3%	98.7%
DC2	DC5	441	38,058	1.1%	98.9%
DC3	DC4	451	38,048	1.2%	98.8%
DC3	DC5	427	38,072	1.1%	98.9%
DC4	DC5	440	38,059	1.1%	98.9%

Note: Z value is 2.15

Table 15–47b. Total Number of Diagnostic Category Significant Differences – Writing/Eng Comp Grades 6–HS

Number of Significant Differences	Number of Students	Percent of Students
0	35,594	92.5%
1	1,774	4.6%
2	725	1.9%
3	287	0.7%
4	107	0.3%
5	7	0.0%
6	5	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

Low numbers of significant differences across diagnostic categories, along with the high disattenuated correlations between categories and exploratory factor analyses discussed in Chapter Seventeen, suggest that some diagnostic categories might be measuring essentially the same construct. While this may be the case in general, when looking at group summary information, diagnostic category scores for individual students can provide useful information to teachers. For example, while 80% of students showed no significant differences between Algebra I diagnostic categories, 20% of students did. CDT diagnostic category scores for these students along with links to instructional resources are a valuable tool for teachers.

The tables in Appendix D show the significant differences with the familywise Type I error rate at 0.10.

DISTRIBUTION OF BENCHMARK RANGES

As described in Chapter Ten, committees of Pennsylvania educators established preliminary CDT cut scores for grade 5 and above prior to the first operational use. Following the 2010–2011 school year, the preliminary cut scores were revised for the mathematics content-area tests. See Chapter Nineteen of the 2010–2011 technical report for details. Following the 2011–2012 school year, the preliminary cut scores were revised for the reading, science, and writing content-area tests. See Chapter Nineteen of the 2011–2012 technical report for details. Cut points for grades 2 through 4 were interpolated from existing cuts in grade 5 and above prior to the first operational use of CDT tests for grades 3 through 5. See Chapter Nineteen of the 2013–2014 technical report for details. Following the 2014–2015 school year, the cut scores were revised for the mathematics, reading, and writing content-area tests based on the revised PSSA tests. See Chapter Nineteen of the 2015–2016 technical report for details.

The benchmark cuts in place during the 2021–2022 school year determine the color ranges (red/green/blue) in the CDT dynamic reporting suite. The cut scores and standard errors (SE)[4] were used to define ranges as follows: The green range is defined as the scale score cut ± one SE. The red range is defined as the scale minimum (200 for all CDTs except Algebra I, Geometry, Algebra II, Biology, and Chemistry which are 400) to the lower bound of the green range. The blue range is defined as the upper bound of the green range to the scale maximum (2000).

Table 15–48 shows the number and percentage of students in each benchmark range for each full CDT test. Tests with multiple benchmark cuts are broken down to match the grade level of the cuts. Tests that are course-specific are not broken down. All results are based on the cut points in place for the 2021–2022 school year.

[4] The standard error was estimated based on simulations using the operational configuration of the CAT in terms of the content constraints and stopping rules.

Table 15–48. Number and Percent of Students in Each CDT Score Range

CDT	Red *N*	Red Percent	Green *N*	Green Percent	Blue *N*	Blue Percent
Math – G3	25,267	77.6%	6,297	19.3%	992	3.0%
Math – G4	26,506	78.4%	6,243	18.5%	1,060	3.1%
Math – G5	32,375	79.7%	7,494	18.5%	741	1.8%
Math – G6	37,422	78.0%	9,028	18.8%	1,526	3.2%
Math – G7	44,376	82.5%	8,401	15.6%	1,012	1.9%
Math – G8	39,194	85.6%	5,834	12.7%	756	1.7%
Math – HS	621	96.7%	21	3.3%	0	0.0%
Algebra I	64,788	84.2%	11,079	14.4%	1,091	1.4%
Geometry	6,648	77.3%	1,686	19.6%	261	3.0%
Algebra II	6,738	81.2%	1,354	16.3%	207	2.5%
Reading – G3	18,251	61.1%	9,709	32.5%	1,908	6.4%
Reading – G4	19,137	58.4%	11,926	36.4%	1,712	5.2%
Reading – G5	21,781	57.6%	14,680	38.8%	1,362	3.6%
Reading – G6	24,806	61.3%	14,728	36.4%	906	2.2%
Reading – G7	26,437	64.1%	14,019	34.0%	773	1.9%
Reading – G8	27,473	68.0%	12,418	30.8%	487	1.2%
Literature	61,892	59.7%	39,455	38.0%	2,403	2.3%
Science – G3	1,679	50.6%	1,245	37.5%	395	11.9%
Science – G4	9,154	46.1%	8,487	42.8%	2,204	11.1%
Science – G5	4,435	56.4%	2,859	36.4%	565	7.2%
Science – G6	10,909	60.6%	6,399	35.5%	700	3.9%
Science – G7	18,624	65.2%	9,309	32.6%	635	2.2%
Science – G8	31,183	67.8%	14,039	30.5%	754	1.6%
Science – HS	1,921	87.0%	277	12.6%	9	0.4%
Biology	60,628	69.3%	23,537	26.9%	3,320	3.8%
Chemistry	4,780	75.8%	1,484	23.5%	38	0.6%
Writing – G3	2,411	65.7%	1,098	29.9%	160	4.4%
Writing – G4	2,894	65.4%	1,402	31.7%	128	2.9%
Writing – G5	3,630	64.8%	1,823	32.5%	149	2.7%
Writing – G6	5,282	60.0%	3,117	35.4%	402	4.6%
Writing – G7	7,281	61.1%	4,130	34.7%	506	4.2%
Writing – G8	7,083	61.3%	4,045	35.0%	425	3.7%
English Composition	3,933	63.2%	1,970	31.6%	325	5.2%

MULTIPLE ADMINISTRATIONS OF THE SAME CDT TEST

As previously indicated, there are a number of students who took the same full CDT test multiple times. This section focuses on the number of days between administrations and both changes in scale score and benchmark range across a student's first and last administrations.

Table 15–49 shows the summary statistics for the number of days from the first to last administration.

Table 15–49. Summary Statistics for Number of Days between Administrations

CDT	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Math Grades 3–5	38,911	0	119	156	168.02	229	278
Math Grades 6–HS	52,572	0	121	164	169.61	224	282
Algebra I	25,340	0	117	160	160.41	203	282
Geometry	3,074	0	110	182	169.19	228	274
Algebra II	2,953	0	134	197	179.84	225	268
Reading Grades 3–5	36,988	0	117	154	162.71	217	272
Reading/Lit Grades 6–HS	80,112	0	117	150	157.80	205	281
Science Grades 3–5	11,046	0	112	149	154.26	191	272
Science Grades 6–HS	32,295	0	124	154	162.71	208	280
Biology	29,410	0	116	161	161.65	216	274
Chemistry	2,287	0	100	150	158.13	217	268
Writing Grades 3–5	5,086	0	112	132	142.64	176	270
Writing/Eng Comp Gr 6–HS	13,305	0	125	150	162.72	209	267

Table 15–50 shows the summary statistics for the change in total scale score from the first to last administration.

Table 15–50. Summary Statistics for Change in Total Scale Score between Administrations

CDT	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Math Grades 3–5	38,911	-594	24	83	85.37	146	743
Math Grades 6–HS	52,572	-579	-13	48	44.79	108	642
Algebra I	25,340	-589	-33	37	31.33	103	754
Geometry	3,074	-565	-16	57	45.24	121	698
Algebra II	2,953	-554	-20	53	40.78	120	660
Reading Grades 3–5	36,988	-589	-20	39	39.12	99	543
Reading/Lit Grades 6–HS	80,112	-646	-55	5	1.96	63	532
Science Grades 3–5	11,046	-520	-14	45	46.49	104	595
Science Grades 6–HS	32,295	-568	-40	19	15.96	74	694
Biology	29,410	-473	-14	54	48.88	116	630
Chemistry	2,287	-403	-37	33	22.85	92	581
Writing Grades 3–5	5,086	-444	-16	41	40.46	96	489
Writing/Eng Comp Gr 6–HS	13,305	-607	-47	14	8.65	72	530

Tables 15–51a through 15–51m show the changes in benchmark range from the first to last administration. For example, 7,726 students who scored in the red range on the first administration of the Math Grades 3–5 test scored in the green range on the last administration.

Table 15–51a. Change in Benchmark Range between First and Last Administrations – Math Grades 3–5

	Red–last test	Green – last test	Blue – last test
Red–first test	26,275	7,726	533
Green–first test	455	2,603	1,015
Blue–first test	20	47	237

Table 15–51b. Change in Benchmark Range between First and Last Administrations – Math Grades 6–HS

	Red – last test	Green – last test	Blue – last test
Red–first test	38,788	7,067	281
Green–first test	912	3,764	1,211
Blue–first test	4	87	458

Table 15–51c. Change in Benchmark Range between First and Last Administrations – Algebra I

	Red – last test	Green – last test	Blue – last test
Red–first test	19,065	3,565	158
Green–first test	412	1,585	398
Blue–first test	0	24	133

Table 15–51d. Change in Benchmark Range between First and Last Administrations – Geometry

	Red – last test	Green – last test	Blue – last test
Red–first test	1,966	602	27
Green–first test	66	271	112
Blue–first test	0	3	27

Table 15–51e. Change in Benchmark Range between First and Last Administrations – Algebra II

	Red – last test	Green – last test	Blue – last test
Red–first test	2,118	550	35
Green–first test	28	137	73
Blue–first test	0	2	10

Table 15–51f. Change in Benchmark Range between First and Last Administrations – Reading Grades 3–5

	Red – last test	Green – last test	Blue – last test
Red–first test	18,343	5,357	67
Green–first test	1,345	9,022	1,678
Blue–first test	20	331	825

Table 15–51g. Change in Benchmark Range between First and Last Administrations – Reading/Lit Grades 6–HS

	Red – last test	Green – last test	Blue – last test
Red–first test	42,841	7,444	10
Green–first test	5,735	21,399	1,283
Blue–first test	15	744	641

Table 15–51h. Change in Benchmark Range between First and Last Administrations – Science Grades 3–5

	Red – last test	Green – last test	Blue – last test
Red–first test	4,101	1,710	79
Green–first test	472	2,964	905
Blue–first test	6	176	633

Table 15–51i. Change in Benchmark Range between First and Last Administrations – Science Grades 6–HS

	Red – last test	Green – last test	Blue – last test
Red–first test	18,279	3,939	25
Green–first test	1,840	7,025	708
Blue–first test	4	169	306

Table 15–51j. Change in Benchmark Range between First and Last Administrations – Biology

	Red – last test	Green – last test	Blue – last test
Red–first test	16,403	6,263	306
Green–first test	752	3,914	1,542
Blue–first test	5	33	192

Table 15–51k. Change in Benchmark Range between First and Last Administrations – Chemistry

	Red – last test	Green – last test	Blue – last test
Red–first test	1,448	482	3
Green–first test	83	248	22
Blue–first test	0	0	1

Table 15–51l. Change in Benchmark Range between First and Last Administrations – Writing Grades 3–5

	Red – last test	Green – last test	Blue – last test
Red–first test	2,830	733	7
Green–first test	181	1,087	159
Blue–first test	1	25	63

Table 15–51m. Change in Benchmark Range between First and Last Administrations – Writing/Eng Comp Grades 6–HS

	Red – last test	Green – last test	Blue – last test
Red–first test	6,872	1,431	6
Green–first test	880	3,242	431
Blue–first test	8	121	314

CHAPTER SIXTEEN: RELIABILITY

This chapter addresses the reliability of Classroom Diagnostic Tools (CDT) test scores. According to the *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 2014), the general notion of reliability/precision refers to

> the consistency of scores across replications of a testing procedure, regardless of how this consistency is estimated or reported (p.33).

Frisbie (2005) highlighted several elements of reliability. First, reliability is a property of test scores, not of a test itself. Many may appreciate this distinction, but in casual usage, individuals frequently make reference to a “reliable test.” While reliability concerns test scores (and not the test specifically), it’s important to appreciate the fact that test scores can be affected by characteristics of the instrument. For example, all other things being equal, tests with more items/points tend to be more reliable than tests with fewer items/points. Second, reliability coefficients are group specific. Reliabilities tend to be higher in populations that are more heterogeneous and lower in populations that are more homogeneous. Consequently, both test length and population heterogeneity should be considered when evaluating reliability.

There are other reliability considerations that may be less evident from the *Standards’* definition yet are still important for test users to understand. While freedom from measurement error is very important, reliability is specifically concerned with random sources of error. Indeed, the degree of inconsistency due to random error sources is what determines reliability: less consistency is associated with lower reliability and more consistency is associated with higher reliability. Of course, systematic error sources also exist. These can artificially increase reliability and decrease validity. Validity is further discussed in Chapter Seventeen.

Another noteworthy issue is that multiple sources of error exist (e.g., the day of testing, the items used). However, most widely used reliability indices only reflect a single type of error. Consequently, it is important for test users to understand what specific type of error is being considered in a reliability study, and equally, if not more importantly, what types are not.

Understanding the distinction between relative error and absolute error is also important, as many reliability indices only reflect relative error. Relative error is of interest whenever the relative ordering of individuals with respect to their test performance is of interest. Understanding examinee rank-order stability is important; however, such stability might be well achieved even when the specific score values are considerably different. When specific score values are considered important (e.g., if cut scores are used), then absolute error is of interest, too. Generally, there is more error variance when considering the absolute scores of examinees, which, in turn, suggests lower reliability.

As the above discussion suggests, reliability is a complex, nonunitary notion that cannot be adequately represented by a single number. There are several reliability indices available, and these may not provide the same results (Frisbie, 2005). The remainder of this chapter covers the following:

- Reliability coefficients and their interpretation
- Unconditional and conditional standard errors of measurement (SEMs and CSEMs)
- Decision consistency

RELIABILITY INDICES

As shown below, the reliability coefficient expresses the consistency of test scores as the ratio of true score variance to total score variance. The total variance contains two components: 1) variance in true scores and 2) variance due to the imperfections in the measurement process. Put differently, total variance equals true score variance plus error variance.[1]

$$\rho_X^2 = \frac{\sigma_T^2}{\sigma_X^2} = \frac{\sigma_T^2}{\sigma_T^2 + \sigma_E^2}$$

[1] A covariance term is not required, as true scores and error are assumed to be uncorrelated in classical test theory.

Reliability coefficients indicate the degree to which differences in test scores reflect true differences in the attribute being tested rather than random fluctuations. Total test score variance (i.e., individual differences) is partly due to real differences in the attribute (true variance) and partly due to random error in the measurement process (error variance).

Reliability coefficients range from 0.0 to 1.0. If all test score variance were true, the index would equal 1.0. The index would be 0.0 if none of the test score variance were true. Such scores would be pure random noise (i.e., all measurement error). If the index had a value of 1.0, scores would be perfectly consistent (i.e., contain no measurement error). Although values of 1.0 are never achieved in practice, it is clear that larger coefficients are more desirable, as they indicate that test scores are less influenced by random error. “How big is big enough?” and “how small is too small?” are issues considered in a later section.

As noted in the introduction, there are several different indices that can be used to estimate this ratio. One approach is referred to as internal consistency, which is derived from analyzing the performance consistency of individuals over the items within a test. As discussed below, these internal consistency indices do not take into account other sources of error, such as day-to-day variations (student health, testing environment, etc.).

COEFFICIENT ALPHA

Although a number of reliability indices exist, one of the most frequently reported for achievement tests is coefficient alpha. For example, both PSSA and Keystone programs report alpha.

FORMULA FOR ALPHA

Consider the following data matrix representing the scores of persons (rows) on items (columns):

Table 16–1. Person × Item Score (*Xpi*) Infinite (Population-Universe) Matrix

Person	Item 1	Item 2	. . .	Item *i*	. . .	Item *k*
Person 1	*Y*11	*Y*12	. . .	*Y*1*i*	. . .	*X*1*k*
Person 2	*Y*21	*Y*22	. . .	*Y*2*i*	. . .	*X*2*k*
. . . .	. . .	. . .	. . .	. . .	. . .	. . .
Person *p*	*Yp*1	*Yp*2	. . .	*Ypi*	. . .	*Xpk*
. . . .	. . .	. . .	. . .	. . .	. . .	. . .
Person *N*	*YN*1	*YN*2	. . .	*YNi*	. . .	*XNk*

Note: Adapted from Cronbach and Shavelson (2004).

Then, a general computational formula for alpha is as follows:

$$\alpha = \frac{N}{N-1}\left(1 - \frac{\sum_{i=1}^{N} \sigma_{Yi}^2}{\sigma_X^2}\right),$$

where N is the number of parts (items or testlets), σ_X^2 is the variance of the observed total test scores, and σ_{Yi}^2 is the variance of part i.

Examination of the formula for alpha indicates why the coefficient is not appropriate for CDT. In the case of CDT, tests are adaptive. Each student takes a unique set of test items rather than the same fixed form. A person item score matrix for CDT analogous to Table 16–1 would include all items in the available item pool (over 5,000 in some cases). Each student takes only a small subset of items (48–60) from the available pool. Summing the variance of more than 5,000 item scores and dividing by the variance of test scores based on 48–60 items is not appropriate. Therefore, a measure of reliability other than alpha must be used for CDT.

SPLIT-HALF RELIABILITY

Like alpha, split-half is an internal consistency index. It can be conceptualized as the extent to which an exchangeable set of items from the same domain would result in a similar rank ordering of students. Note that relative error is reflected in this index. Variation in student performance from one sample of items to the next should be of particular concern for any test user. Consider two hypothetical vocabulary tests intended for the same group of students. Each test contains different sets of unique words that are believed to be randomly equivalent, perhaps like the ones shown below:

Table 16–2. Two Hypothetical Vocabulary Tests

Test One	Test Two
Abase	Abate
Boon	Bilk
Capricious	Circuitous
Deface	Debase
....	....
Zealous	Zenith

If a representative group of students could take both of these tests, the correlation between the scores obtained would represent the parallel forms reliability of the test scores. However, such data-collection designs are impractical in large-scale settings and experimental confounds like fatigue and practice effects are likely to affect the results. Internal-consistency reliability indices arose in part to provide reliability measures using the data from just a single test administration. So, if students only took Test One and the split-half reliability index for those test scores was high, this would suggest that Test Two would provide a very similar rank ordering of the students if they had taken it instead. If split-half reliability was low, dissimilar rank orderings would likely be observed—again, relative-error variance is reflected.

CALCULATION OF SPLIT-HALF RELIABILITY

To determine split-half reliability for a given CDT test, such as Biology, each administration of the test was split into two halves. Each item's difficulty was considered in the split so the halves represent approximately equivalent alternative forms. Rasch ability estimates were then calculated for each of the two halves. Then, Pearson correlation was computed between the Rasch ability estimates from the two halves. Finally, the Pearson correlation was adjusted for test length using the Spearman-Brown prediction formula as described below.

Split-Half reliability = $\frac{2r}{1+r}$ where r = Pearson correlation

Split-half reliability is related to coefficient alpha in that alpha is often interpreted as the mean of all possible split-half coefficients.

FURTHER INTERPRETATIONS

What reliability value is considered high enough? What values are considered too low? Although frequently asked for, any rules of thumb for interpreting the magnitude of reliability indices are mostly arbitrary. One approach is to research the reliabilities from similar testing instruments to see what values are commonly observed. For 2022 PSSA tests in Mathematics, English Language Arts (ELA), and Science, reliability coefficients ranged from 0.84 to 0.92. For spring 2022 Keystone exams in Algebra I, Biology, and Literature reliability coefficients were 0.92, 0.93, and 0.91, respectively. For many other state assessment programs, reliabilities in the low 0.90s are usually the highest observed, and reliabilities in the high 0.80s are very common.

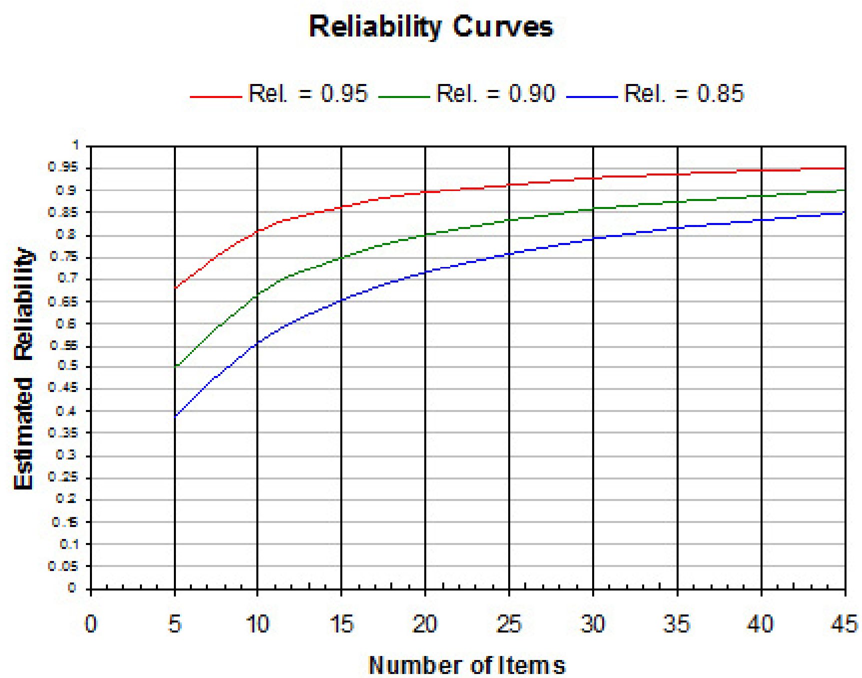
The lower a given reliability coefficient, the greater the potential for over-interpretation of the associated results. As suggested earlier, there is no firm guideline regarding how low is too low. However, as an informative point of reference, a reliability coefficient of 0.50 would mean that there is as much error variance as true-score variance in the scores.

DIAGNOSTIC CATEGORY SCORE RELIABILITY

$$SEM = SD\sqrt{1—reliability}$$

As noted in the introduction, reliabilities tend to be higher with an increase in test length and lower with a decrease in test length. Figure 16–1 illustrates this relationship for a hypothetical 45-item test with three total score reliabilities: 0.95, 0.90, and 0.85. As an example, the curve for reliability equal to 0.90 suggests that a 10-item diagnostic category score would be expected to have a score reliability of just over 0.65. The use of the Spearman-Brown prediction formula assumes all items are exchangeable, which, in practice, they may not be. While such a chart may not perfectly model actual diagnostic category reliability, the intent is to illustrate the substantial impact that limited numbers of items can have on diagnostic category score reliability.

Figure 16–1. Example of the Relationship between Test Length and Reliability



STANDARD ERROR OF MEASUREMENT

The reliability coefficient is a unit-free indicator that reflects the degree to which scores are free of measurement error. It always ranges between 0.0 and 1.0 regardless of the test's scale. Reliability coefficients best reflect the extent to which measurement inconsistencies may be present or absent in a group. However, they are not that useful for helping users interpret test scores. The standard error of measurement (SEM) is another indicator of test score precision that is better suited for determining the effect of measurement inconsistencies on the scores obtained by individual examinees. This is particularly so for conditional SEMs (CSEM) discussed further below.

TRADITIONAL STANDARD ERROR OF MEASUREMENT

A precise, theoretical interpretation of the SEM is somewhat unwieldy. A beginning point for understanding the concept is as follows. If everyone being tested had the same true score,[2] there would still be some variation in observed scores due to imperfections in the measurement process, such as random differences in attention during instruction or concentration during testing, the sampling of test items, etc. The standard error is defined as the standard deviation[3] of the distribution of observed scores for students with identical true scores. Because the SEM is an index of the random variability in test scores in actual score units, it represents very important information for test score users.

[2] True score is the score the person would receive if the measurement process were perfect.

[3] The standard deviation of a distribution is a measure of the dispersion of the observations. For the normal distribution, about 16 percent of the observations are more than one standard deviation above the mean.

The SEM formula is provided below:

It indicates that the value of the SEM depends on both the reliability coefficient and the standard deviation of test scores. If the reliability were equal to 0.00 (the lowest possible value), the SEM would be equal to the standard deviation of the test scores. If test reliability were equal to 1.00 (the highest possible value), the SEM would be 0.0. In other words, a perfectly reliable test has no measurement error (Harvill, 1991). Additionally, the value of the SEM takes the group variation (i.e., score standard deviation) into account.

TRADITIONAL SEM CONFIDENCE INTERVALS

The SEM is an index of the random variability in test scores in actual score units, which is why it has such great utility for test score users. SEMs allow statements regarding the precision of individual tests scores. SEMs help place reasonable limits (Gulliksen, 1950) around observed scores through construction of an approximate score band. Often referred to as confidence intervals, these bands are constructed by taking the observed scores, X, and adding and subtracting a multiplicative factor of the SEM. As an example, students with a given true score will have observed scores that fall between ± 1 SEM about two-thirds of the time.[4] For ±2 SEM confidence intervals, the percentage increases to about 95 percent.

FURTHER INTERPRETATIONS

ONE SEM FOR ALL TEST SCORES

The SEM approach described above only provides a single numerical estimate for constructing the confidence intervals for examinees regardless of their score levels. In reality, however, such confidence intervals vary according to one's score. Consequently, care should be taken when using the SEM for students with extreme scores. An alternate approach is described in the next section that conditions the SEM on a student's score estimate.

GROUP SPECIFIC

As noted in the introduction, reliabilities are group specific. The same is true for SEMs because both score reliabilities and score standard deviations vary across groups.

SCALE SCORE METRIC

The SEM approach is calculated using scale scores, and as such, the resulting confidence interval bands are in the scale score metric.

TYPE OF ERROR REFLECTED

The interpretation of the SEM should be driven by the type of score reliability that underpins it. So, the CDT SEMs involve the same source of error relevant to internal consistency indices. As noted earlier, a precise technical explanation of the SEM (and resulting confidence intervals) can be unwieldy. Because of this, score users are often provided less complex interpretations.

One simpler description sometimes used is that a confidence interval represents the possible score range that one would observe if a student could be tested twice with the same instrument. Taking the same test on a different day implies the only source of random error being considered is related to the occasion of testing—such as a student might be sleepier one day than another, might be sick, or might not have eaten a good breakfast. There is a reliability index that captures this source of random error and it is referred to as the test-retest reliability coefficient. This is not the type of reliability computed for the CDT. When internal consistency reliability estimates are used, such an explanation blurs the fact that random error based on the occasion of testing is not considered.

[4] Some prefer the following interpretation: if a student were tested an infinite number of times, the ± 1 SEM confidence intervals constructed for each score would capture the student's true score 68 percent of the time.

When SEMs are derived from internal consistency reliability estimates, a better approach is to describe the confidence interval as providing reasonable bounds for the range of scores that a student might receive if he or she took an equivalent version of the test. That is, the student took a test that covered exactly the same content, but included a different set of items. As an example, if the Algebra I score was 1078 and the SEM band was 1038 to 1118, then a student would be likely to receive a score somewhere between 1038 and 1118 if he or she took a different version of the test without additional instruction.

RESULTS AND OBSERVATIONS

Split-half reliability coefficients and associated (traditional) SEMs for CDT tests are presented in Table 16–3. Values were derived using the operational data from the 2021–2022 school year. The results are presented for total scores and each diagnostic category score. The statistics reported include number of students tested (*N*), mean scale score, standard deviation of scale score, split-half reliability, and traditional standard error of measurement (SEM) in the scale score metric.

Table 16–3. CDT Reliabilities

CDT	Score	Average Number of Points	*N*	Scale Score Mean	Scale Score SD	Split-Half Reliability	SEM in Scale Score Metric
Math Grades 3–5	**Total**	51.7	106,975	774.080	167.669	0.944	39.6
Math Grades 3–5	Numbers and Operations	12.9	106,975	772.145	193.798	0.825	81.1
Math Grades 3–5	Algebraic Concepts	12.9	106,975	782.339	185.370	0.806	81.7
Math Grades 3–5	Geometry	12.9	106,975	755.226	173.663	0.777	82.0
Math Grades 3–5	Measurement, Data, and Probability	12.9	106,975	776.468	188.067	0.811	81.7
Math Grades 6–HS	**Total**	52.2	148,191	934.111	158.878	0.941	38.8
Math Grades 6–HS	Numbers and Operations	13.0	148,191	940.259	192.198	0.838	77.4
Math Grades 6–HS	Algebraic Concepts	13.1	148,191	937.652	182.074	0.817	78.0
Math Grades 6–HS	Geometry	13.0	148,191	937.015	163.555	0.777	77.3
Math Grades 6–HS	Measurement, Data, and Probability	13.1	148,191	925.078	181.804	0.813	78.6
Algebra I	**Total**	52.8	76,958	986.260	155.361	0.934	40.0
Algebra I	Operations with Real Numbers and Expressions	13.2	76,958	977.526	205.033	0.856	77.9
Algebra I	Linear Equations & Inequalities	13.2	76,958	1001.126	161.588	0.754	80.1
Algebra I	Functions & Coordinate Geometry	13.1	76,958	1000.066	167.074	0.776	79.0
Algebra I	Data Analysis	13.2	76,958	972.043	183.132	0.810	79.7
Geometry	**Total**	52.6	8,595	1054.156	158.869	0.938	39.7
Geometry	Geometric Properties	13.0	8,595	1049.575	175.131	0.803	77.7
Geometry	Congruence, Similarity, & Proofs	13.2	8,595	1065.401	178.597	0.795	80.9
Geometry	Coordinate Geometry and Right Triangles	13.2	8,595	1059.761	188.318	0.826	78.5
Geometry	Measurement	13.2	8,595	1045.245	187.944	0.821	79.4

Table 16–3 (continued). CDT Reliabilities

CDT	Score	Average Number of Points	*N*	Scale Score Mean	Scale Score SD	Split-Half Reliability	SEM in Scale Score Metric
Algebra II	**Total**	52.9	8,299	1092.502	161.704	0.940	39.6
Algebra II	Operations with Complex Numbers	13.4	8,299	1143.869	195.390	0.833	79.9
Algebra II	Non-linear Expressions & Equations	13.1	8,299	1080.180	195.160	0.835	79.3
Algebra II	Functions	13.1	8,299	1095.206	176.102	0.797	79.2
Algebra II	Data Analysis	13.3	8,299	1058.796	192.916	0.835	78.4
Reading Grades 3–5	**Total**	57.6	100,466	784.140	165.634	0.926	45.1
Reading Grades 3–5	Key Ideas and Details-Literature Text	11.8	100,466	781.601	202.815	0.734	104.7
Reading Grades 3–5	Key Ideas and Details-Informational Text	11.5	100,466	775.984	197.934	0.716	105.4
Reading Grades 3–5	Craft and Structure-Literature Text	11.6	100,466	798.873	185.583	0.661	108.1
Reading Grades 3–5	Craft and Structure-Informational Text	11.6	100,466	777.859	199.574	0.720	105.5
Reading Grades 3–5	Vocabulary Acquisition and Use	11.1	100,466	774.346	210.811	0.747	106.1
Reading/Lit Grades 6–HS	**Total**	56.7	225,797	934.760	160.310	0.924	44.2
Reading/Lit Grades 6–HS	Key Ideas and Details-Literature Text	11.8	225,797	932.358	193.835	0.713	103.8
Reading/Lit Grades 6–HS	Key Ideas and Details-Informational Text	11.5	225,797	938.341	194.361	0.712	104.3
Reading/Lit Grades 6–HS	Craft and Structure-Literature Text	11.3	225,797	938.260	179.998	0.666	104.0
Reading/Lit Grades 6–HS	Craft and Structure-Informational Text	11.4	225,797	929.149	200.910	0.730	104.3
Reading/Lit Grades 6–HS	Vocabulary Acquisition and Use	10.7	225,797	931.046	214.535	0.744	108.6
Science Grades 3–5	**Total**	51.4	31,023	737.496	166.384	0.937	41.9
Science Grades 3–5	The Nature of Science	12.8	31,023	729.646	187.212	0.784	87.0
Science Grades 3–5	Biological Sciences	12.9	31,023	733.736	186.530	0.787	86.1
Science Grades 3–5	Physical Sciences	12.9	31,023	742.130	180.319	0.770	86.4
Science Grades 3–5	Earth and Space Sciences	12.8	31,023	736.797	175.699	0.756	86.9
Science Grades 6–HS	**Total**	52.3	94,759	839.269	148.719	0.924	40.9
Science Grades 6–HS	The Nature of Science	13.0	94,759	833.916	183.501	0.795	83.2
Science Grades 6–HS	Biological Sciences	13.1	94,759	837.364	180.366	0.786	83.4
Science Grades 6–HS	Physical Sciences	13.1	94,759	851.053	161.912	0.733	83.6
Science Grades 6–HS	Earth and Space Sciences	13.1	94,759	837.307	159.440	0.725	83.7

Table 16–3 (continued). CDT Reliabilities

CDT	Score	Average Number of Points	*N*	Scale Score Mean	Scale Score SD	Split-Half Reliability	SEM in Scale Score Metric
Biology	**Total**	52.5	87,485	930.513	149.520	0.923	41.4
Biology	Basic Biological Principles/ Chemical Basis for Life	13.1	87,485	927.259	184.063	0.793	83.8
Biology	Bioenergetics/Homeostasis and Transport	13.1	87,485	942.071	154.421	0.703	84.1
Biology	Cell Growth and Reproduction/ Genetics	13.2	87,485	942.805	163.518	0.732	84.7
Biology	Theory of Evolution/Ecology	13.1	87,485	912.659	188.359	0.804	83.4
Chemistry	**Total**	53.0	6,302	958.882	116.562	0.864	43.0
Chemistry	Properties and Classification of Matter	13.2	6,302	916.871	191.700	0.811	83.4
Chemistry	Atomic Structure and the Periodic Table	13.3	6,302	993.649	121.796	0.500	86.1
Chemistry	The Mole and Chemical Bonding	13.2	6,302	973.066	129.904	0.567	85.5
Chemistry	Chemical Relationships and Reactions	13.3	6,302	959.832	136.387	0.603	86.0
Writing Grades 3–5	**Total**	54.7	13,695	757.499	179.274	0.948	41.1
Writing Grades 3–5	Quality of Writing: Focus and Organization	11.0	13,695	745.604	207.695	0.798	93.3
Writing Grades 3–5	Quality of Writing: Content and Style	10.9	13,695	752.896	200.459	0.780	94.1
Writing Grades 3–5	Quality of Writing: Editing	10.9	13,695	754.350	198.154	0.774	94.2
Writing Grades 3–5	Conventions: Punctuation, Capitalization, and Spelling	10.9	13,695	763.271	192.498	0.760	94.2
Writing Grades 3–5	Conventions: Grammar and Sentence Formation	11.0	13,695	760.688	205.011	0.795	92.7
Writing/Eng Comp Gr 6–HS	**Total**	55.6	38,499	893.138	173.275	0.948	39.5
Writing/Eng Comp Gr 6–HS	Quality of Writing: Focus and Organization	11.1	38,499	885.341	208.188	0.806	91.8
Writing/Eng Comp Gr 6–HS	Quality of Writing: Content and Style	11.2	38,499	896.301	204.001	0.795	92.4
Writing/Eng Comp Gr 6–HS	Quality of Writing: Editing	11.1	38,499	888.066	198.287	0.792	90.5
Writing/Eng Comp Gr 6–HS	Conventions: Punctuation, Capitalization, and Spelling	11.1	38,499	904.627	198.863	0.791	91.0
Writing/Eng Comp Gr 6–HS	Conventions: Grammar and Sentence Formation	11.1	38,499	885.798	193.491	0.782	90.3

The overall test score reliability values are high and similar to those reported for PSSA and Keystone Exams. The reliabilities at the diagnostic category level are lower due to the fact that each diagnostic category contains fewer items.

RASCH CONDITIONAL STANDARD ERRORS OF MEASUREMENT

The CSEM also indicates the degree of measurement error in scale score units, but varies as a function of a student's actual scale score. Therefore, the CSEM may be especially useful in characterizing measurement precision in the neighborhood of a score level used for decision-making—such as cut scores for identifying students who meet a performance standard.

Technically, when a Rasch model is applied, the CSEM at any given point on the ability continuum is defined as the reciprocal of the square root of the test information function derived from the Rasch scaling model:

$$CSEM(\hat{\beta}_n) = \frac{1}{\sqrt{I(\hat{\beta}_n)}},$$

where $CSEM(\hat{\beta}_n)$ is the conditional standard error of measurement and $I(\hat{\beta}_n)$ is the test information function. Test information depends on the sum of the corresponding information functions for the test items. Item information depends on each item's difficulty and conditional item score variance. The formula above utilizes the Rasch ability ($\hat{\beta}_n$) metric. The conditional standard error on the scale score (SS) metric is determined simply by multiplying the $CSEM(\hat{\beta}_n)$ by the slope (multiplicative constant, *m*) of the linear transformation equation used to convert the Rasch ability estimates to scale scores:

$$CSEM(\text{SS}) = CSEM(\hat{\beta}_n) * m$$

Chapter Eleven provides the linear transformation formulas for each of the CDT content areas.

RASCH CSEM CONFIDENCE INTERVALS

CSEMs also allow statements regarding the precision of individual tests scores. And like SEMs, they help place reasonable limits around observed scale scores through construction of an approximate score band. The confidence intervals are constructed by adding and subtracting a multiplicative factor of the CSEM and may be interpreted as described in the earlier section.

FURTHER INTERPRETATIONS

DIFFERENT CSEMS FOR DIFFERENT TEST SCORES

The CSEM approach provides different numerical estimates for constructing the confidence intervals for examinees depending on their specific score. On fixed form tests, the magnitude of the CSEM values is often "U" shaped, with larger CSEM values associated with lower and higher scores. With a fixed set of items, there is less information for students scoring at the extremes, and CSEM is inversely related to the information function (the more information, the lower the CSEM). Given that CDT tests are adaptive, this "U" shape tends to be less pronounced as students are presented with items targeted at their level. While there is some "U" shape at the extreme ends of the vertical scale, there is a much larger area on the scale where CSEMs are relatively flat compared to fixed form tests. The adaptive tests allow for greater information and, therefore, lower CSEMs across a wide range of the vertical scale.

GROUP SPECIFIC

Assuming reasonable model-data fit—as explored in Chapter Eight—the Rasch based CSEMs (conditioned on score level) should not vary across groups.

SCALE SCORE METRIC

The CSEM and associated confidence interval bands are in the scale score metric.

TYPE OF ERROR REFLECTED

The CSEMs reported in the dynamic reporting suite are the Rasch-based conditional standard errors of measurement described above. Score report content is considered in greater detail in Chapter Fourteen.

RESULTS AND OBSERVATIONS

Figures 16–2 through 16–14 show the average Rasch CSEMs associated with various scale score ranges based on operational data from the 2021–2022 school year. The values are fairly consistent across a large range of scores on the vertical scale. The values increase at the low and high ends of the scale score range.

Figure 16–2. Average Conditional Standard Errors for Math Grades 3–5

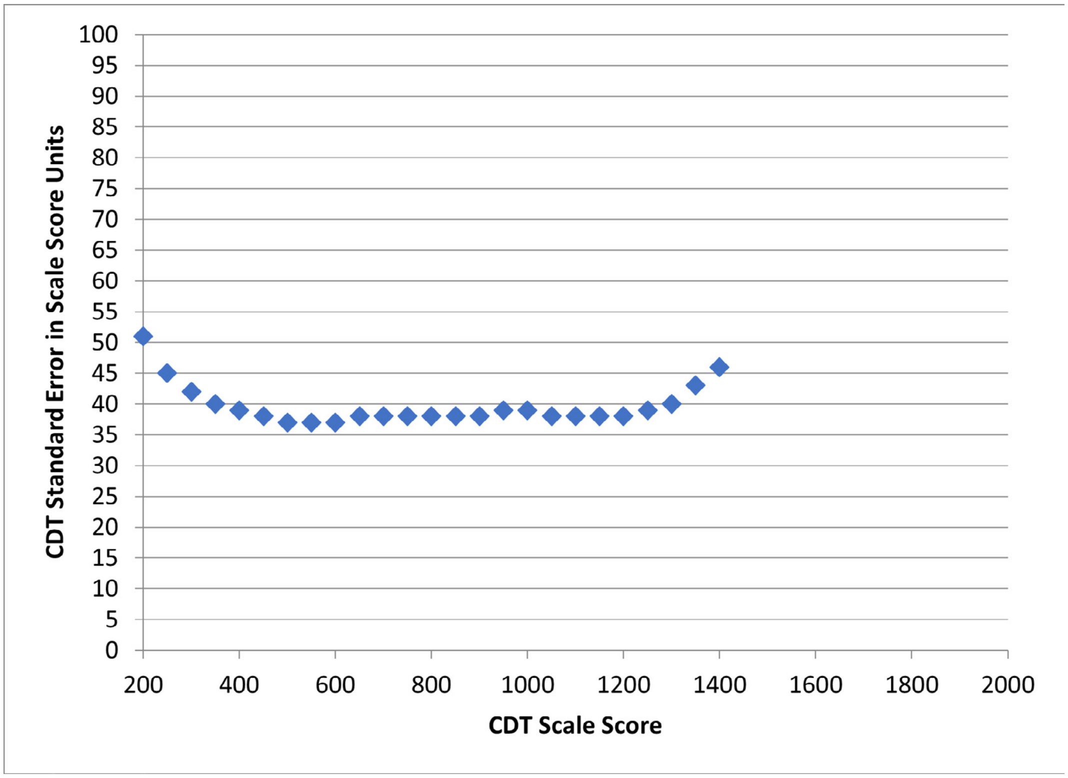


Figure 16–3. Average Conditional Standard Errors for Math Grades 6–HS

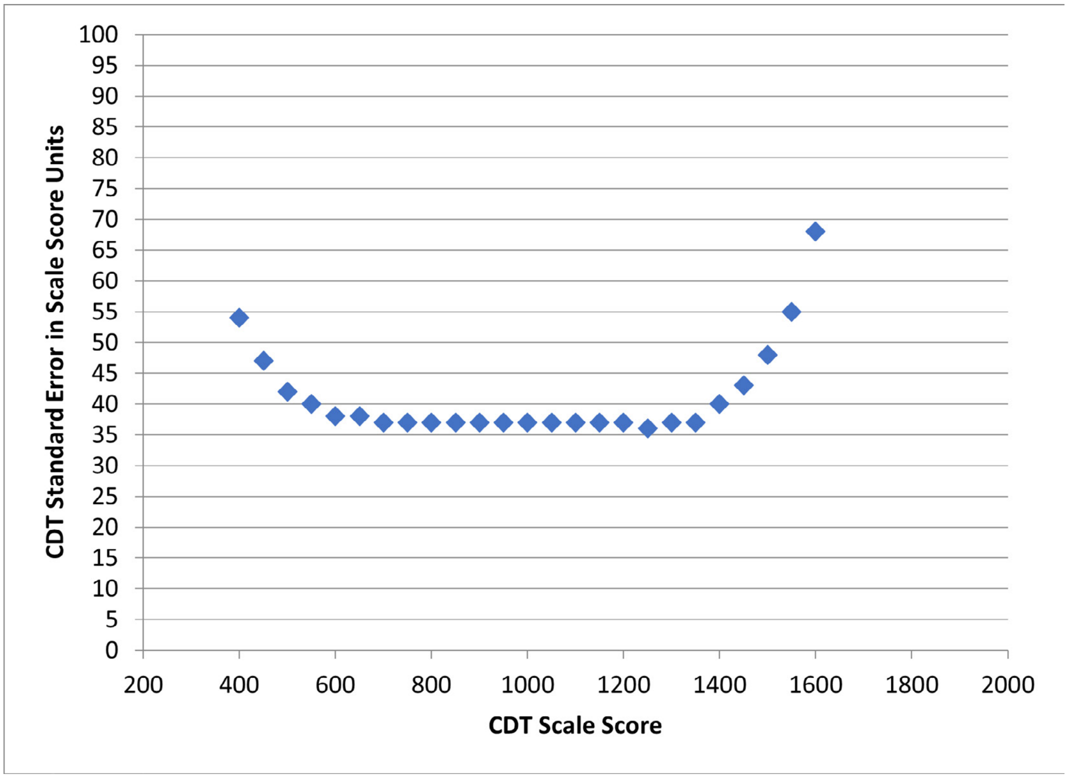


Figure 16–4. Average Conditional Standard Errors for Algebra I

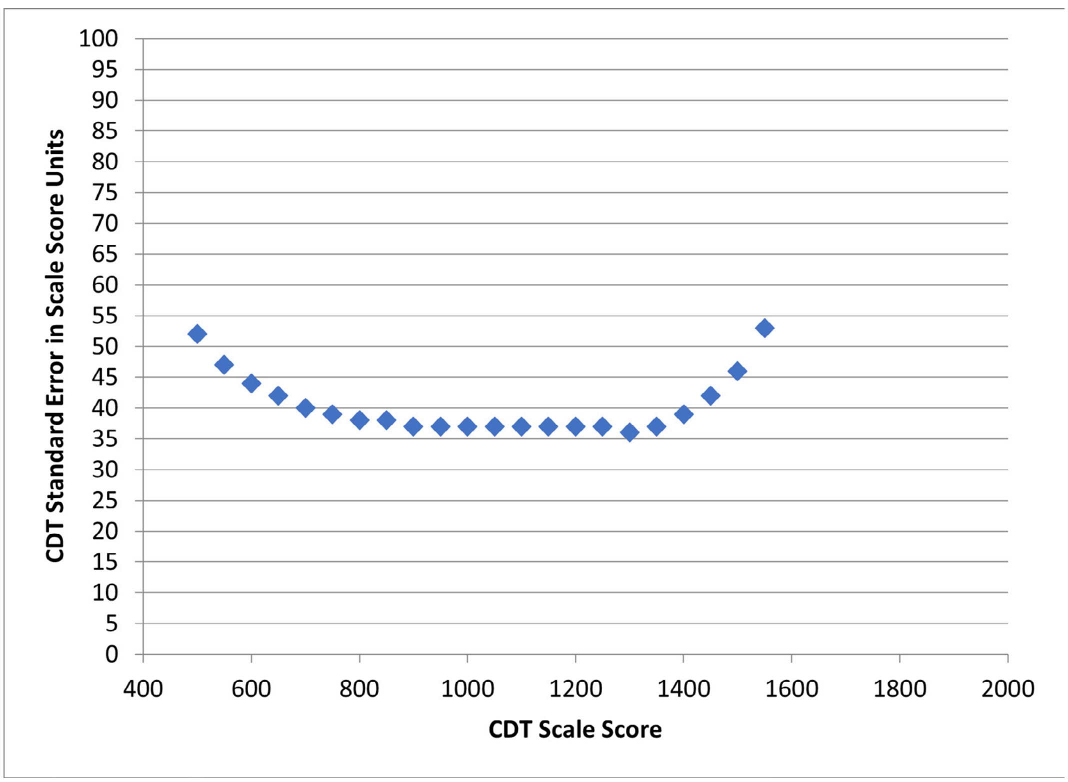


Figure 16–5. Average Conditional Standard Errors for Geometry

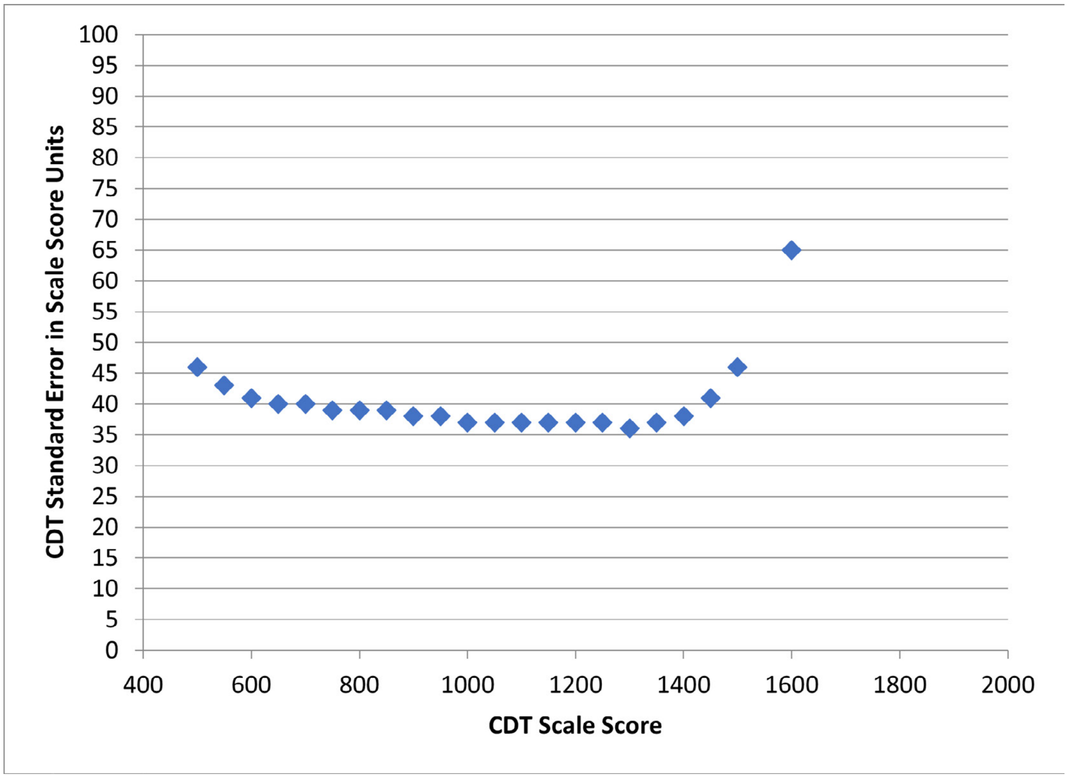


Figure 16–6. Average Conditional Standard Errors for Algebra II

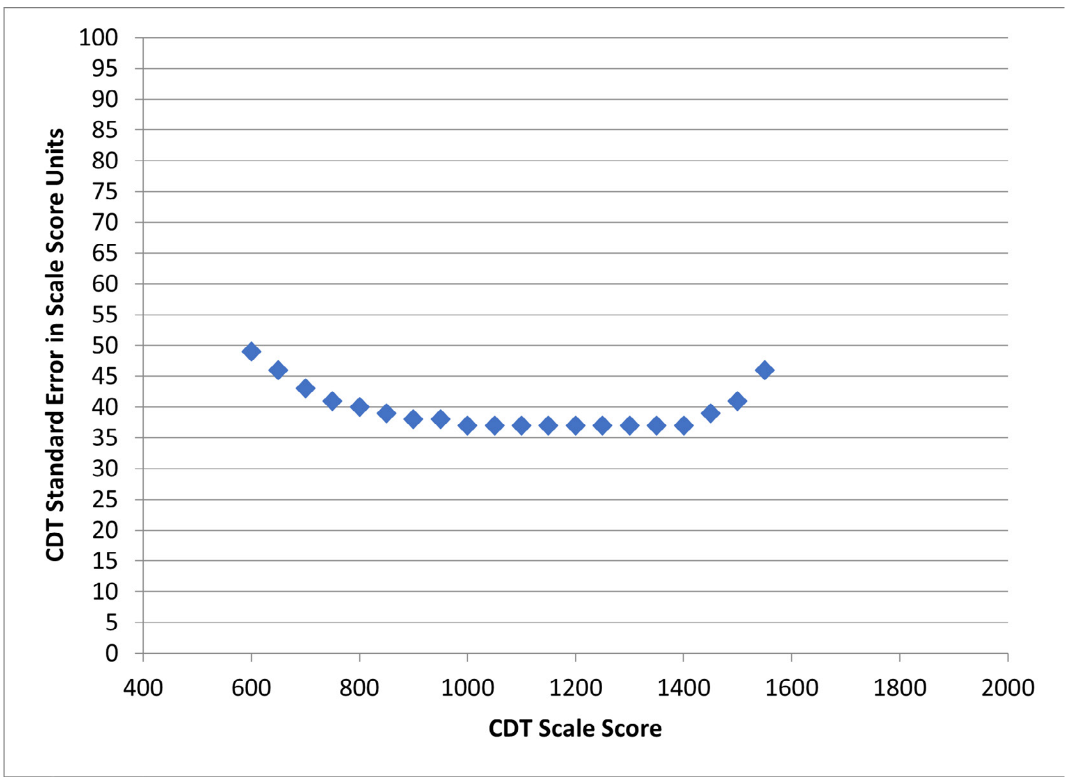


Figure 16–7. Average Conditional Standard Errors for Reading Grades 3–5

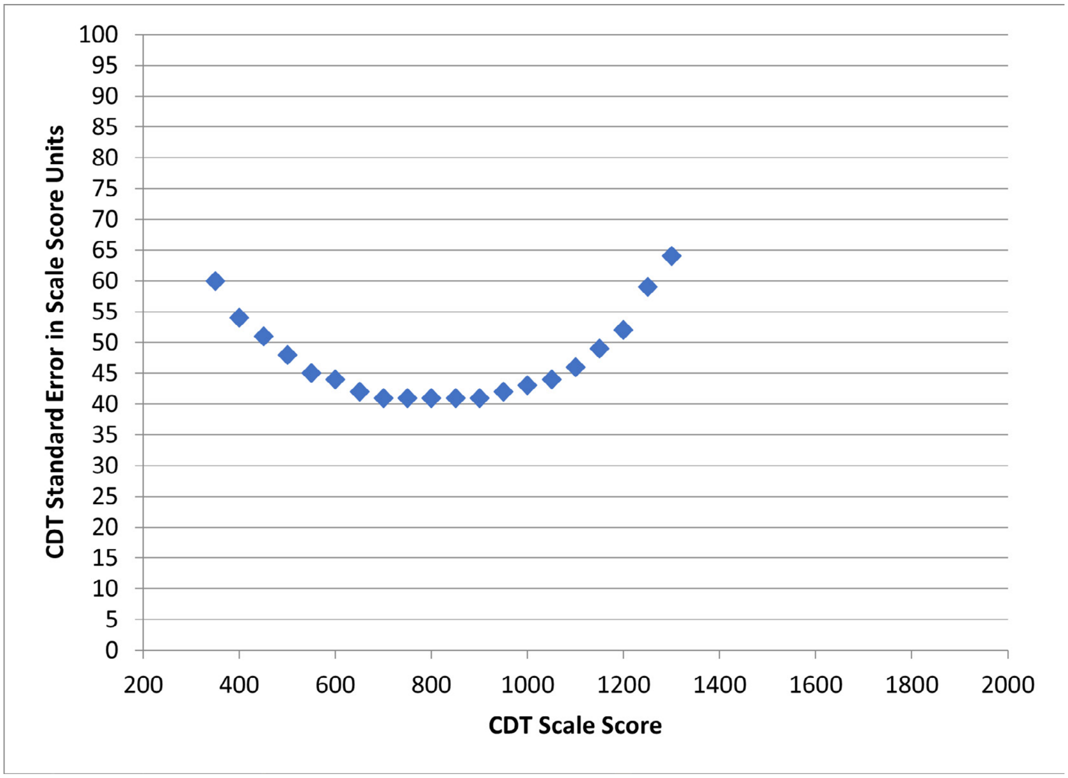
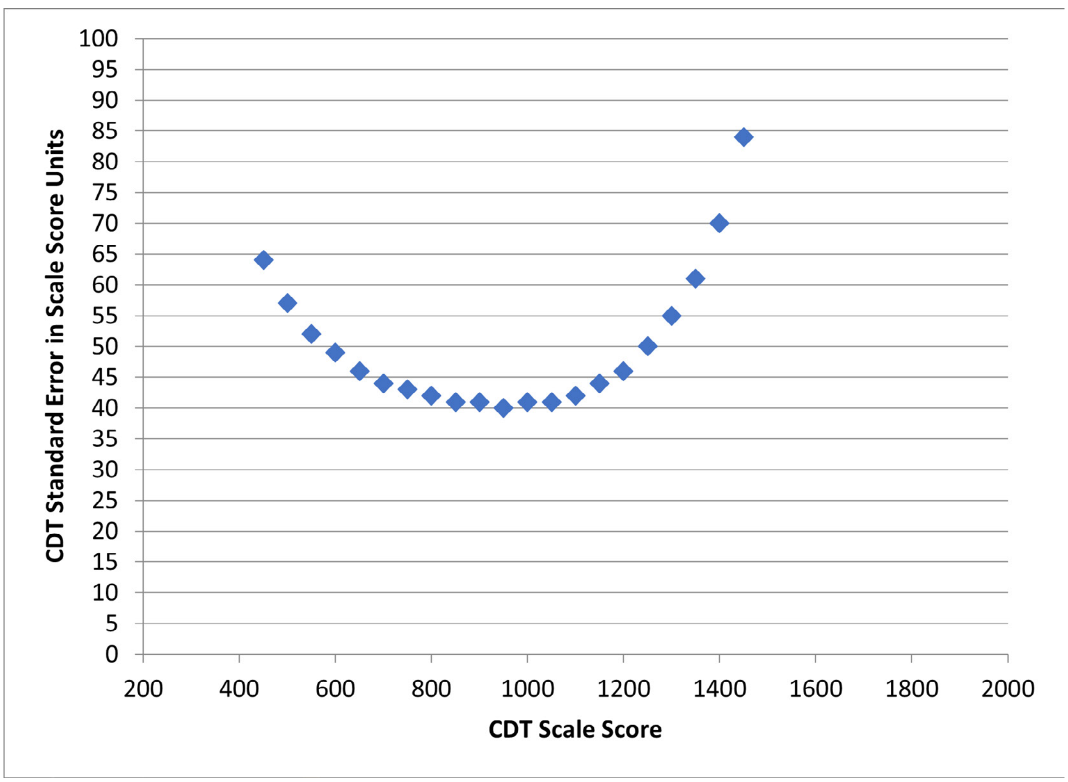


Figure 16–8. Average Conditional Standard Errors for Reading/Lit Grades 6–HS



CSEMs tend to be higher in the reading content area. This is due to the fact that CDT Reading Grades 3–5 and CDT Reading/Lit Grades 6–HS are passage-based. The items from a selected passage may not be as closely targeted to the student's level as when individual items are selected one at a time. For more information on adaptive selection of passages, see Chapter Thirteen.

Figure 16–9. Average Conditional Standard Errors for Science Grades 3–5

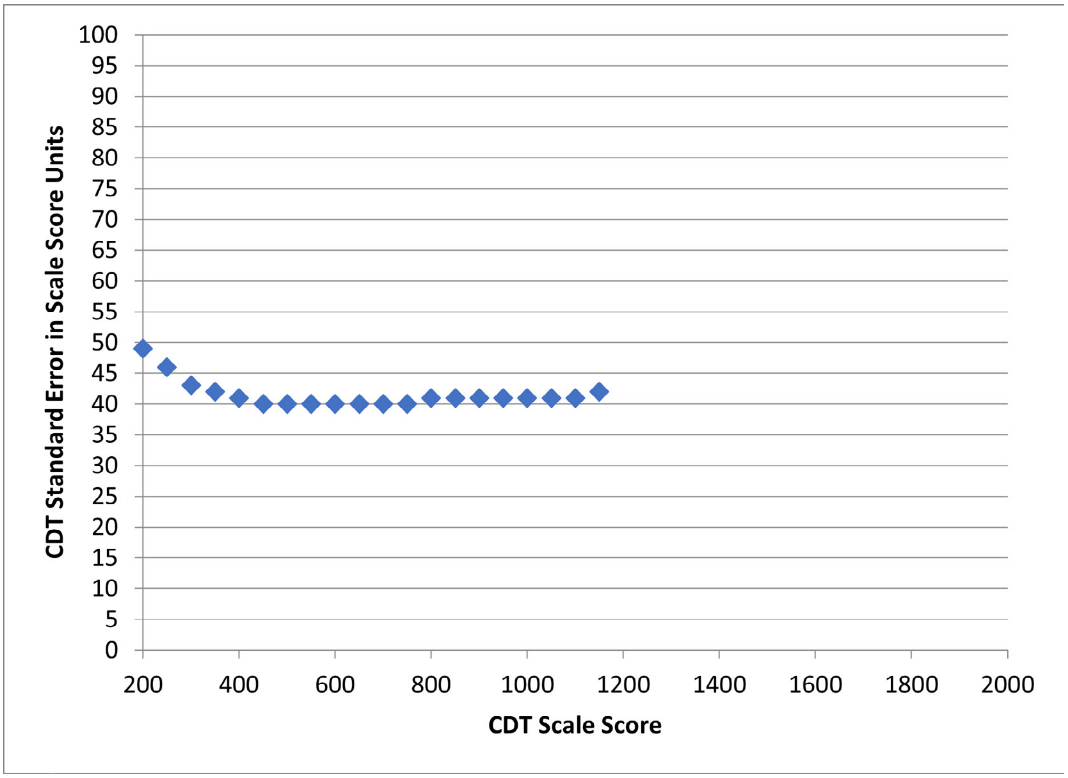


Figure 16–10. Average Conditional Standard Errors for Science Grades 6–HS

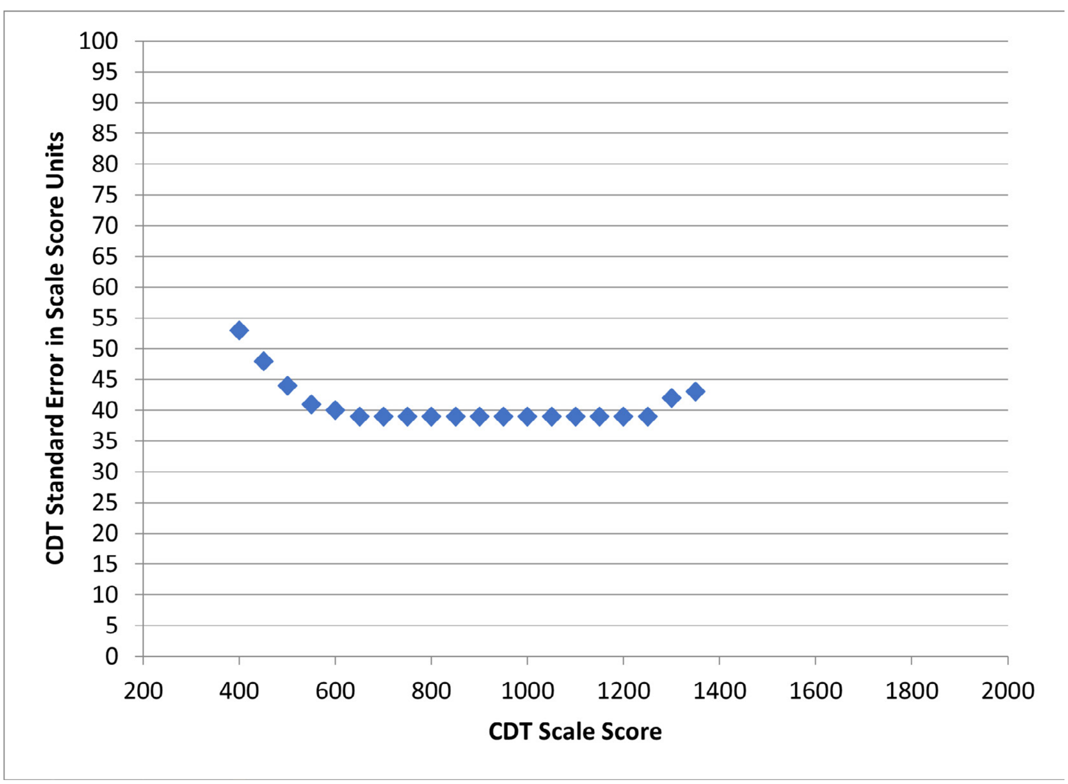


Figure 16–11. Average Conditional Standard Errors for Biology

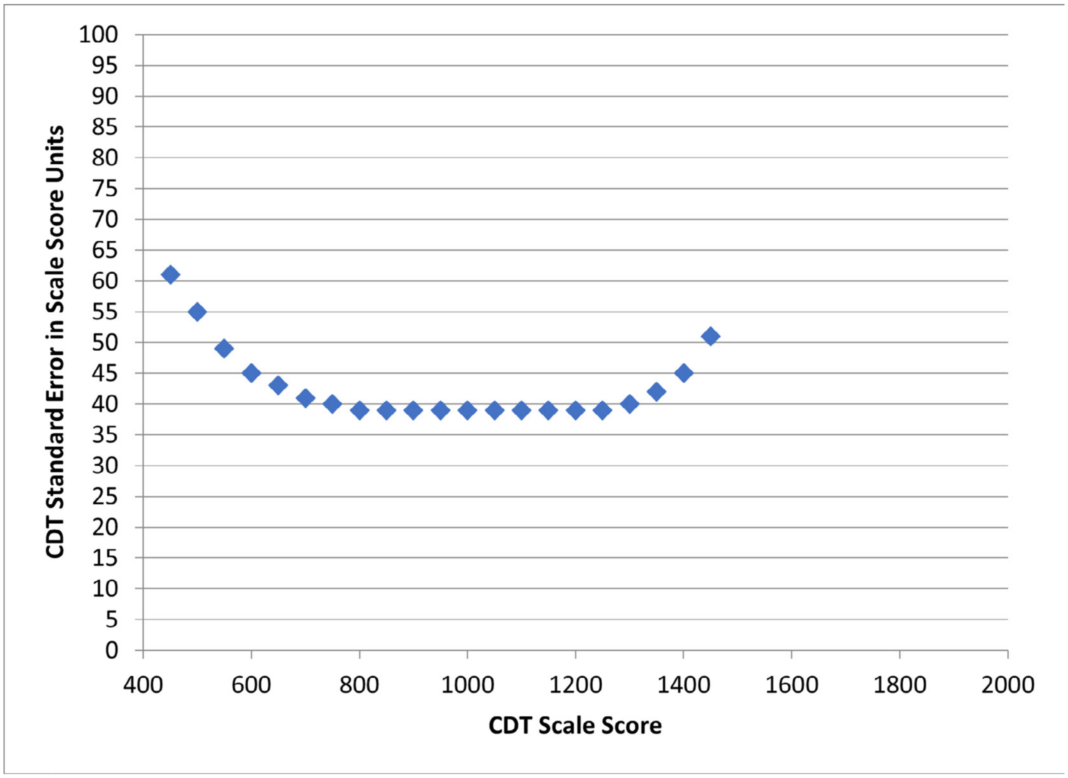


Figure 16–12. Average Conditional Standard Errors for Chemistry

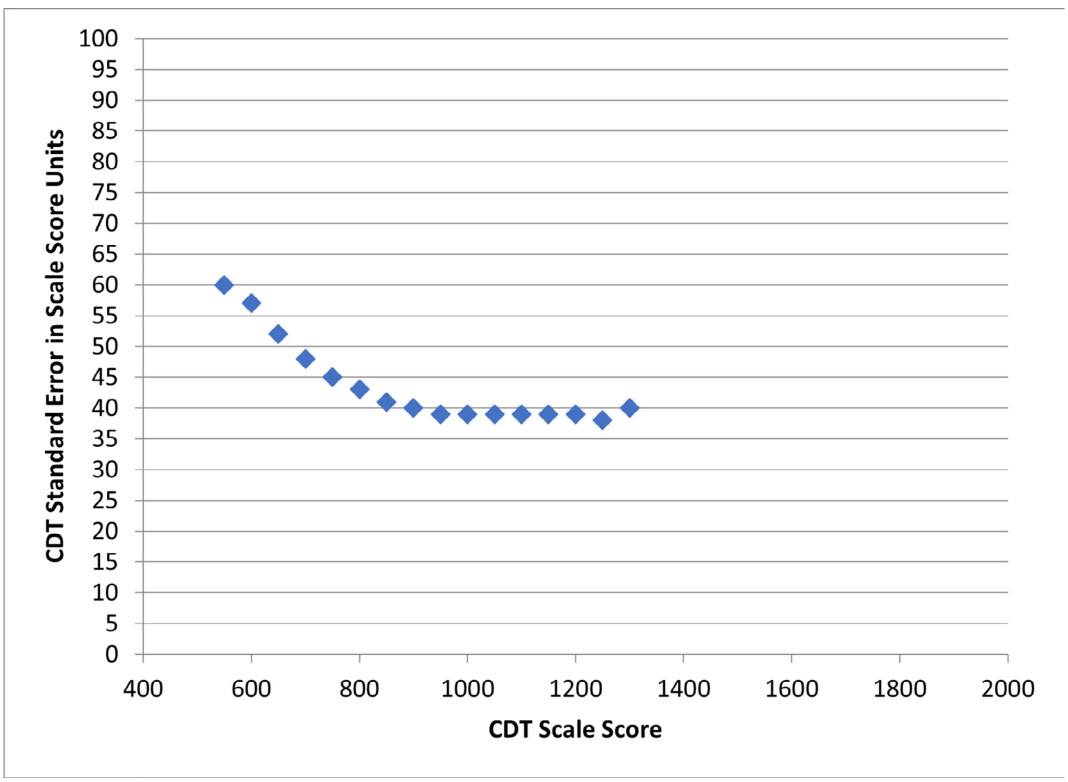


Figure 16–13. Average Conditional Standard Errors for Writing Grades 3–5

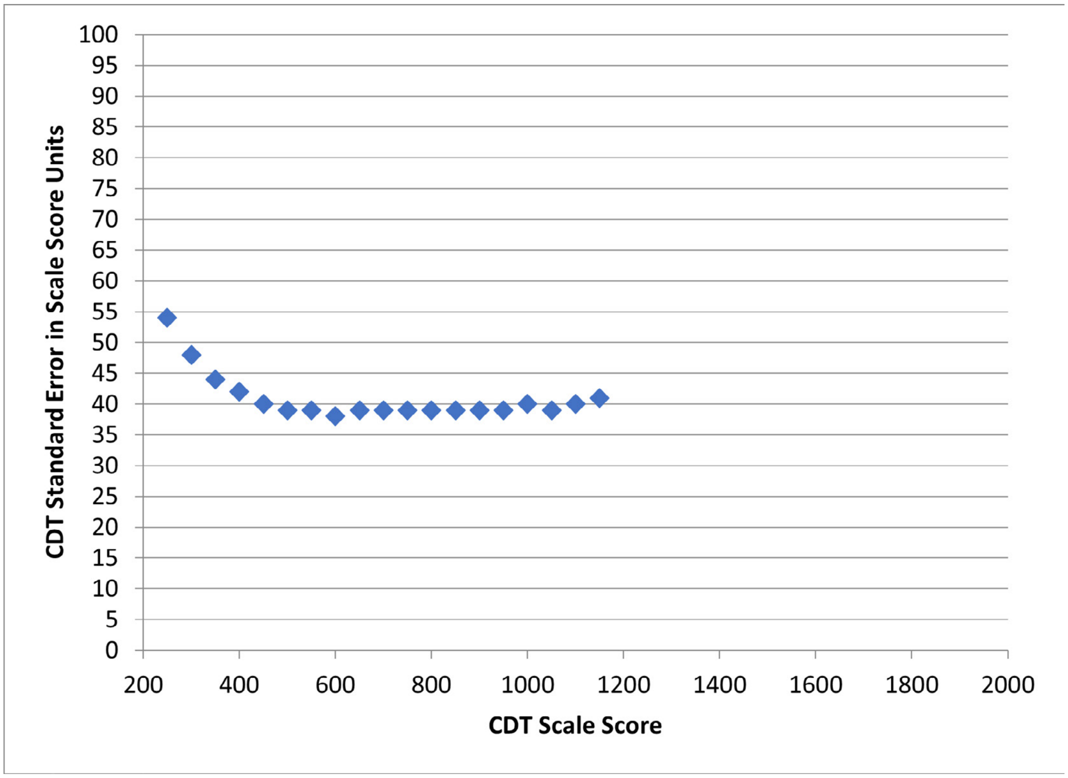
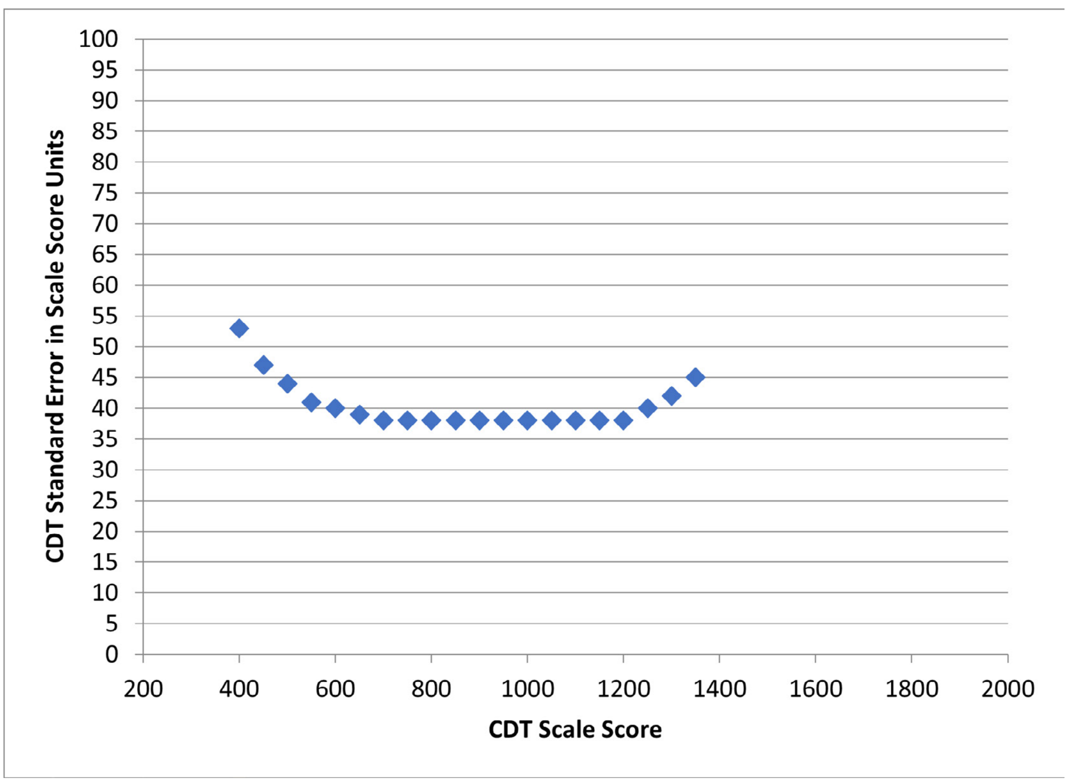


Figure 16–14. Average Conditional Standard Errors for Writing/Eng Comp Grades 6–HS



DECISION CONSISTENCY

Classification decision consistency refers to the degree to which the achievement level for each student can be replicated upon retesting using an equivalent form (Huynh, 1976). While CDT is designed to be administered multiple times in the school year to gauge progress following instruction, retesting in the context of decision consistency refers to retesting shortly after testing without additional instruction.

In a standards-based testing program, there should be great interest in knowing how accurately students are classified into performance categories. In contrast to reliability, which is concerned with the relative rank-ordering of students, it is the absolute values of student scores that are important in decision consistency.

Decision consistency answers the question "What is the agreement between the classifications based on two non-overlapping, equally difficult forms of the test?" If two parallel forms of the test were given to the same students (without additional instruction), the consistency of the measure would be reflected by the extent to which the classification decisions made based on the first set of test scores matched the decisions based on the second set of test scores. Consider Table 16–4:

Table 16–4. Pseudo-Decision Table for Three Hypothetical Categories

Test Level	Test One – Level I	Test One – Level II	Test One – Level III	Test One – Marginal
Test Two – Level I	φ_{11}	φ_{12}	φ_{13}	$\varphi_{1\bullet}$
Test Two – Level II	φ_{21}	φ_{22}	φ_{23}	$\varphi_{2\bullet}$
Test Two – Level III	φ_{31}	φ_{32}	φ_{33}	$\varphi_{3\bullet}$
Test Two – Marginal	$\varphi_{\bullet 1}$	$\varphi_{\bullet 2}$	$\varphi_{\bullet 3}$	1

If a student is classified as in one category based on Test One's score, how probable would it be that the student would be reclassified in the same category if he or she took Test Two (a non-overlapping, equally difficult form of the test)?

The proportions of correct decisions, φ, for three categories is computed as:

$$\tilde{O} = \varphi 11 + \varphi 22 + \varphi 33$$

It is the sum of the diagonal entries—that is, the proportion of students classified by the two forms into exactly the same level—that would signify the overall consistency.

Since it is not feasible to repeat CDT tests one right after the other with no additional instruction in order to estimate the proportion of students who would be reclassified in the same performance levels, a statistical model needs to be imposed on the data in order to project the consistency of classifications solely using data from the available administration (Hambleton and Novick, 1973). Two well-known methods were developed by Hanson and Brennan (1990) and Livingston and Lewis (1995) utilizing specific true score models. While both measures are reported for PSSA and Keystone Exams, the statistical models imposed on the data depend upon a beta binomial distribution of raw scores. Given that the CDT is adaptive (i.e., raw scores using a response probability of 0.5 are generally equal to one-half of test length), these measures are not reported for CDT. Instead, decision consistency measures in this section are a Rasch-based index that relies on conditional standard errors (CSEMs). Also reported are results based on simulations and kappa.

The decision consistency measures reported in the section are based on the Rasch model and conditional standard errors (Stearns and Smith, 2007). Each person's scale score has an associated conditional standard error. Each of the performance levels on the test has an established benchmark cut in the scale score metric. Given these three pieces of information, the assumption of a normal distribution of measurement error allows one to calculate the probability that a student would receive the same classification on retesting. Using the statistic:

$$z = \frac{SS_n - SSBC}{SE_{SS_n}}$$

where *SSn* is the scale score estimate for person *n*, *SSBC* is the scale score benchmark cut, and $SE_{ss,}$ is the asymptotic standard error of the person scale score estimate. Using cumulative normal probabilities, the probability that a retest would produce the same performance level classification and the probability of a different performance level classification were calculated. The process was repeated for each cut score which results in a probability of classification in each of the performance levels. The total classification rate for the entire sample is the average of the probabilities of the same classification on retesting.

Table 16–5 provides an example based on CDT Algebra I operational data from the 2021–2022 school year. Recall that in the dynamic reporting suite, scores are classified into one of three color ranges—red, green, or blue. The benchmark cut points used for the analyses are the cut points in place during the 2021–2022 school year.

Table 16–5. Retest Classification Probability – Algebra I

	Red – retest	Green – retest	Blue – retest
Red – test	0.956	0.044	0.000
Green – test	0.164	0.803	0.033
Blue – test	0.000	0.170	0.830

Consider students with scores in the green range: The probability of scoring in the red range if retested is 0.164. The probability of scoring in the green range again is 0.803. The probability of scoring in the blue range is 0.033.

The total classification rate is determined by taking the weighted average of the diagonal probabilities where the weights are the number of students in the corresponding range. There are 76,958 students in the sample: 64,788 with total scores in the red range, 11,079 in the green range, and 1,091 in the blue range. The total classification rate is [(0.956)*(64,788)+(0.803)*(11,079)+(0.830)*(1,091)]/76,958 = 0.932.

In addition to the exact agreement rate, Cohen's kappa[5] was also calculated as 0.759.

In cases with multiple categories, an alternative to kappa, which treats every misclassification as equally important, is a weighted kappa that considers differences that are non-adjacent as more "off." While relevant, given there are three categories, weighted kappa is the same as kappa in this case because both the red/blue and blue/red cells in Table 16–5 are zero.

3 X 3 retest classification probability tables for all CDT tests and benchmark cuts comparable to Table 16–5 are presented in Appendix E.

Stearns and Smith (2007) point out that one advantage of this method is that each student can understand how likely it is that he or she would be classified in the same range if the student took the test over without additional instruction. In addition, each student can learn the probability with which he or she would be reclassified in any of the ranges. A student scoring right at the cut score will have a lower rate of consistent classification than a student scoring in the middle of a performance level band. This can be seen in Table 16–6, which is based on the same Algebra I data set and cut points and shows for various scale scores the percent chance of scoring in each color range if retested.

[5] Kappa, κ, takes into account the agreement occurring by chance.

Table 16–6. Retest Classification Percent for Various Scale Score Ranges – Algebra I

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 400	0	N/A	N/A	N/A	N/A
400 to 449	0	N/A	N/A	N/A	N/A
450 to 499	3	>99.9%	0.0%	0.0%	>99.9%
500 to 549	47	>99.9%	0.0%	0.0%	>99.9%
550 to 599	332	>99.9%	0.0%	0.0%	>99.9%
600 to 649	1,117	>99.9%	0.0%	0.0%	>99.9%
650 to 699	2,199	>99.9%	0.0%	0.0%	>99.9%
700 to 749	2,998	>99.9%	0.0%	0.0%	>99.9%
750 to 799	3,857	>99.9%	0.0%	0.0%	>99.9%
800 to 849	4,764	>99.9%	0.0%	0.0%	>99.9%
850 to 899	5,901	>99.9%	0.0%	0.0%	>99.9%
900 to 949	7,227	>99.9%	0.0%	0.0%	>99.9%
950 to 999	8,822	>99.9%	0.0%	0.0%	>99.9%
1000 to 1049	10,504	99.7%	0.3%	0.0%	99.7%
1050 to 1099	10,726	93.1%	6.9%	0.0%	93.1%
1100 to 1149 (Red/Green cut = 1134)	8,592	60.4%	39.6%	0.0%	65.0%
1150 to 1199	5,065	16.4%	83.5%	0.1%	83.5%
1200 to 1249	2,516	1.2%	96.1%	2.7%	96.1%
1250 to 1299 (Green/Blue cut = 1297)	1,248	0.0%	74.4%	25.5%	74.5%
1300 to 1349	593	0.0%	25.9%	74.1%	74.1%
1350 to 1399	247	0.0%	2.8%	97.2%	97.2%
1400 to 1449	120	0.0%	0.1%	99.9%	99.9%
1450 to 1499	41	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	19	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	10	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	3	0.0%	0.0%	>99.9%	>99.9%
1650 to 1699	3	0.0%	0.0%	>99.9%	>99.9%
1700 to 1749	2	0.0%	0.0%	>99.9%	>99.9%
1750 to 1799	1	0.0%	0.0%	>99.9%	>99.9%
1800 to 1849	1	0.0%	0.0%	>99.9%	>99.9%
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	76,958				

* Retest assuming no additional instruction

Tables for all CDT tests and benchmark cuts comparable to Table 16–6 are presented in Appendix E.

As previously mentioned, it is not feasible to repeat CDT tests one right after the other with no additional instruction in order to estimate decision consistency. However, simulations were run as a validation of the results based on the Stearns and Smith method. The reported Algebra I scores from 2021–2022 were used as true scores in order to simulate retest results. Table 16–7 repeats the Algebra I results from Table 16–5, shows the simulation results, and displays the differences.

Table 16–7. Compare Stearns and Smith Results to Simulation Retest Classification Probability – Algebra I

	Red – retest	Green – retest	Blue – retest
Red – Stearns & Smith	0.956	0.044	0.000
Green – Stearns & Smith	0.164	0.803	0.033
Blue – Stearns & Smith	0.000	0.170	0.830

Exact Agreement Rate = 0.932
Kappa = 0.759

	Red – retest	Green – retest	Blue – retest
Red – Simulated test	0.955	0.045	0.000
Green – Simulated test	0.174	0.793	0.033
Blue – Simulated test	0.000	0.172	0.828

Exact Agreement Rate = 0.930
Kappa = 0.750

	Red – retest	Green – retest	Blue – retest
Red – Difference	0.001	-0.001	0.000
Green – Difference	-0.010	0.010	0.000
Blue – Difference	0.000	-0.002	0.002

Exact Agreement Rate = 0.002
Kappa = 0.009

Based on results of the simulation validation, Stearns and Smith methodology was applied to all CDT tests and benchmark cut points using data from the 2021–2022 school year. Results are presented in Table 16–8.

Table 16–8. Decision Consistency for All CDT Tests

CDT	Benchmark Cut	N-count	Exact Agreement Rate	Kappa
Mathematics Grades 3–5	Grade 3	32,556	0.923	0.789
Mathematics Grades 3–5	Grade 4	33,809	0.924	0.788
Mathematics Grades 3–5	Grade 5	40,610	0.924	0.775
Mathematics Grades 6–HS	Grade 6	47,976	0.926	0.794
Mathematics Grades 6–HS	Grade 7	53,789	0.934	0.782
Mathematics Grades 6–HS	Grade 8	45,784	0.939	0.764
Mathematics Grades 6–HS	High School	642	0.969	0.628
Algebra I	Algebra I	76,958	0.932	0.759
Geometry	Geometry	8,595	0.919	0.782
Algebra II	Algebra II	8,299	0.933	0.790
Reading Grades 3–5	Grade 3	29,868	0.907	0.821
Reading Grades 3–5	Grade 4	32,775	0.904	0.817
Reading Grades 3–5	Grade 5	37,823	0.905	0.817
Reading/Lit Grades 6–HS	Grade 6	40,440	0.903	0.803
Reading/Lit Grades 6–HS	Grade 7	41,229	0.907	0.804
Reading/Lit Grades 6–HS	Grade 8	40,378	0.913	0.803
Reading/Lit Grades 6–HS	Literature	103,750	0.901	0.803
Science Grades 3–5	Grade 3	3,319	0.883	0.802
Science Grades 3–5	Grade 4	19,845	0.867	0.777
Science Grades 3–5	Grade 5	7,859	0.882	0.784
Science Grades 6–HS	Grade 6	18,008	0.892	0.788
Science Grades 6–HS	Grade 7	28,568	0.898	0.784
Science Grades 6–HS	Grade 8	45,976	0.901	0.778
Science Grades 6–HS	High School	2,207	0.939	0.741
Biology	Biology	87,485	0.898	0.774
Chemistry	Chemistry	6,302	0.901	0.737
Writing Grades 3–5	Grade 3	3,669	0.909	0.809
Writing Grades 3–5	Grade 4	4,424	0.905	0.799
Writing Grades 3–5	Grade 5	5,602	0.897	0.784
Writing/Eng Comp Gr 6–HS	Grade 6	8,801	0.893	0.791
Writing/Eng Comp Gr 6–HS	Grade 7	11,917	0.897	0.797
Writing/Eng Comp Gr 6–HS	Grade 8	11,553	0.903	0.807
Writing/Eng Comp Gr 6–HS	English Composition	6,228	0.912	0.824

See Appendix E for the 3 X 3 retest classification probability tables.

CHAPTER SEVENTEEN: VALIDITY

As defined 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” (p. 11). The *Standards* provides a framework for describing the sources of evidence that should be considered when evaluating validity. These sources include evidence based on 1) test content, 2) response processes, 3) the internal structure of the test, 4) the relationships between test scores and other variables, and 5) the consequences of testing. In addition, when Item Response Theory (IRT) models are used to analyze assessment data, validity considerations related to those processes should also be explored.

The validity process involves the collection of a variety of evidence to support the proposed test score interpretations and uses. The entire technical report describes the technical aspects of the Classroom Diagnostic Tools (CDT) in support of its score interpretations and uses. Each of the previous chapters contributes important evidence components that pertain to score validation: test development, test administration, test scoring, item analysis, Rasch calibration, scaling, equating, score reporting, and reliability. This chapter is used to summarize and synthesize the evidence based on the framework of the *Standards*. The purposes and intended use of the CDT is reviewed first, and then each type of validity evidence is addressed in turn.

PURPOSES AND INTENDED USES OF THE CDT

The *Standards* emphasize that validity pertains to how test scores are used. To help contextualize the evidence that will be presented below, the purposes of the CDT will be reviewed first. The CDT was developed to support teachers and students in grades 3 through 12. These tools, available at no cost to districts, are fully integrated and aligned in the Standards Aligned System (SAS) and enable educators to identify students’ academic strengths and areas of need, as well as provide links to classroom resources. The assessment is administered completely online using a computer adaptive test (CAT) model, and participation is voluntary. CDT scores are available immediately after testing in the dynamic reporting suite. In addition to the scores, this suite includes links to instructional resources. The CDT may be used multiple times throughout the school year.

EVIDENCE BASED ON TEST CONTENT

Test content validity evidence for the CDT rests greatly on establishing a link between each piece of the assessment (i.e., the items) and what students should know and be able to do as prescribed by the Assessment Anchors and Eligible Content. The CDT is intended to measure the knowledge and skills described in the Assessment Anchors and Eligible Content for grades 3 through 8 and high school in mathematics, reading, science, and writing, and courses Algebra I, Geometry, Algebra II, Literature, Biology, Chemistry, and English Composition.

Lane (1999) suggests taking the following steps to support the content validity of an assessment. In the case of the operational CDT, one should:

- evaluate the degree to which the test specifications represent and align with the knowledge and skills described in the corresponding Assessment Anchors and Eligible Content.
- evaluate the alignment between the CDT items and test specifications to ensure representativeness.
- evaluate the extent to which the curriculum aligns with the Assessment Anchors and Eligible Content.
- conduct content reviews of the CDT items using a panel of content experts to see whether items measure the intended construct or are the sources of construct-irrelevant variance.
- conduct fairness reviews of the items to avoid issues related to a specific subpopulation.
- evaluate procedures for administration and scoring such as the appropriateness of instructions to examinees, practice/training with online tools and tests, and time limits for the assessments.
- submit operational tests to third-party independent reviews.

Chapters Two through Five of this report present a considerable amount of evidence related to test content. As described in these chapters, all the items were developed and aligned with the Assessment Anchors and Eligible Content. After development and prior to field testing, items were reviewed for content and bias issues. After being field tested, items were reviewed with respect to their statistical properties and alignment with the learning progressions. Items selected for inclusion in the operational pools had to pass content, psychometric, and PDE reviews. Tests were administrated according to standardized procedures with allowable accommodations.

Some of the efforts made to ensure content validity are summarized below.

- DRC used Webb's (1999) Depth of Knowledge (DOK) model to ensure the CDT items aligned with the Assessment Anchors and Eligible Content and the Academic Content Standards in terms of both content and cognitive levels.
- DRC established detailed test and item/passage development specifications and ensured the items were sufficient in number and adequately distributed across content, levels of cognitive complexity, and levels of difficulty.
- DRC selected qualified item writers and provided training to help ensure they wrote high-quality items.
- All newly developed items were first reviewed by content specialists and editors at DRC to make sure they measured the intended Assessment Anchors and Eligible Content. Appropriateness for the intended students was also considered, as well as depth of knowledge, graphics, grammar/punctuation, language demand, and distractor reasonableness.
- Prior to field testing, the test items were submitted to content committees (composed of Pennsylvania educators) for review using, but not limited to, the following categories:
    - Overall quality and clarity
    - Anchor, Eligible Content, and/or standard alignment
    - Grade-level appropriateness
    - Difficulty level
    - Depth of knowledge
    - Appropriate sources of challenge (e.g., unintended content and skills)
    - Correct answer
    - Quality of distractors
    - Graphics
    - Appropriate language demand
    - Freedom from bias
- The items were also submitted to a Bias, Fairness, and Sensitivity Committee for review. This committee reviewed items for issues related to diversity, gender, and other pertinent factors.
- Items passing all prior hurdles were tried out in a stand-alone or embedded field-test event. Several statistical analyses were conducted on the field-test data including classical item analyses, distractor analyses, and differential item functioning (DIF) analyses. Items were again carefully reviewed by DRC staff and a committee of Pennsylvania teachers with respect to their statistical characteristics. DIF was used to detect test items that might bias test scores for particular groups. Empirical investigation of DIF strengthens the validity evidence related to score interpretations for students in particular groups by eliminating potential sources of construct-irrelevant variance.
- Following field testing, the items were submitted to content committees (composed of Pennsylvania educators) for review and alignment with the learning progressions.
- The CDT was administered according to standardized procedures with allowable accommodations. Students were given ample time to complete the tests (i.e., there were no speediness issues).

EVIDENCE BASED ON RESPONSE PROCESS

Response-process evidence is used to examine the extent to which the cognitive skills and processes employed by students match those identified in the test developer's defined construct domains for all students and for each subgroup. Think-aloud procedures or "cognitive labs" can be used to collect this type of evidence.

For the operational 2021–2022 CDT, no cognitive lab studies were conducted to collect the response process evidence.

EVIDENCE BASED ON INTERNAL STRUCTURE

As described in the *Standards* (2014), internal-structure evidence refers to the degree to which the relationships among test items and test components conform to the construct on which the proposed test interpretations are based. For each CDT, one total test score as well as diagnostic category scores were reported (see Chapter Fourteen for more information about CDT scores). Several dimensionality studies were conducted in order to provide internal-structure evidence relating to the use of both types of scores.

ITEM-TEST CORRELATIONS

Item-test correlations are discussed in Chapter Seven and provided in Appendix B of the 2017–2018, 2018–2019, and 2019-2020 technical reports. All items in the final operational pools had values that were positive and of acceptable magnitude.

DIMENSIONALITY

Dimensionality analyses were conducted for the CDT using WINSTEPS's principal components analyses on response residuals for each content area. Results are shown in Chapter Eight. The principal component analysis results provided evidence that each CDT test was essentially unidimensional, supporting the validity of using the total scores to estimate a student's overall ability.

DIAGNOSTIC CATEGORY CORRELATIONS

Correlations and disattenuated correlations among diagnostic category scores for the CDT are presented below. Values were derived from the CDT operational data from the 2021–2022 school year. This data can also provide information on score dimensionality that is part of internal-structure evidence. Each CDT has either four or five diagnostic categories. Full diagnostic category names can be found in Chapter Thirteen.

Table 17–1. Correlations among Diagnostic Categories — Math Grades 3–5

Diagnostic Category	Numbers.	Alg. Con	Geo.	Meas.
Numbers.	-	-	-	-
Alg. Con.	0.779	-	-	-
Geo.	0.710	0.697	-	-
Meas.	0.774	0.775	0.711	-

Table 17–2. Correlations among Diagnostic Categories — Math Grades 6–HS

Diagnostic Category	Numbers.	Alg. Con	Geo.	Meas.
Numbers.	-	-	-	-
Alg. Con.	0.736	-	-	-
Geo.	0.692	0.679	-	-
Meas.	0.723	0.706	0.677	-

Table 17–3. Correlations among Diagnostic Categories — Algebra I

Diagnostic Category	Operations.	Linear.	Functions.	Data.
Operations.	-	-	-	-
Linear.	0.641	-	-	-
Functions.	0.659	0.652	-	-
Data.	0.657	0.636	0.665	-

Table 17–4. Correlations among Diagnostic Categories — Geometry

Diagnostic Category	Properties.	Congruence.	Coordinate.	Measure.
Properties.	-	-	-	-
Congruence.	0.664	-	-	-
Coordinate.	0.675	0.673	-	-
Measure.	0.683	0.666	0.690	-

Table 17–5. Correlations among Diagnostic Categories — Algebra II

Diagnostic Category	Complex.	Non-Linear.	Functions.	Data.
Complex.	-	-	-	-
Non-Linear.	0.603	-	-	-
Functions.	0.579	0.707	-	-
Data.	0.505	0.685	0.674	-

Table 17–6. Correlations among Diagnostic Categories — Reading Grades 3–5

Diagnostic Category	Key – Lit.	Key – Info.	Craft – Lit.	Craft – Info.	Vocab.
Key – Lit.	-	-	-	-	-
Key – Info.	0.681	-	-	-	-
Craft – Lit.	0.677	0.648	-	-	-
Craft – Info.	0.672	0.676	0.647	-	-
Vocab.	0.702	0.686	0.661	0.689	-

Table 17–7. Correlations among Diagnostic Categories — Reading/Lit Grades 6–HS

Diagnostic Category	Key – Lit.	Key – Info.	Craft – Lit.	Craft – Info.	Vocab.
Key – Lit.	-	-	-	-	-
Key – Info.	0.645	-	-	-	-
Craft – Lit.	0.647	0.631	-	-	-
Craft – Info.	0.654	0.678	0.644	-	-
Vocab.	0.661	0.667	0.648	0.683	-

Table 17–8. Correlations among Diagnostic Categories — Science Grades 3–5

Diagnostic Category	Nature.	Bio.	Phys.	Earth/Space.
Nature.	-	-	-	-
Bio.	0.776	-	-	-
Phys.	0.767	0.763	-	-
Earth/Space.	0.754	0.750	0.743	-

Table 17–9. Correlations among Diagnostic Categories — Science Grades 6–HS

Diagnostic Category	Nature.	Bio.	Phys.	Earth/Space.
Nature.	-	-	-	-
Bio.	0.713	-	-	-
Phys.	0.683	0.676	-	-
Earth/Space.	0.680	0.677	0.648	-

Table 17–10. Correlations among Diagnostic Categories — Biology

Diagnostic Category	Basic.	Bioenerg.	Cell Growth.	Evol./Ecol.
Basic.	-	-	-	-
Bioenerg.	0.665	-	-	-
Cell Growth.	0.671	0.630	-	-
Evol./Ecol.	0.701	0.637	0.670	-

Table 17–11. Correlations among Diagnostic Categories — Chemistry

Diagnostic Category	Matter.	Atomic.	Mole.	Chem.
Matter.	-	-	-	-
Atomic.	0.480	-	-	-
Mole.	0.535	0.469	-	-
Chem.	0.519	0.442	0.478	-

Table 17–12. Correlations among Diagnostic Categories — Writing Grades 3–5

Diagnostic Category	Focus.	Content.	Edit.	Punct.	Gram.
Focus.	-	-	-	-	-
Content.	0.776	-	-	-	-
Edit.	0.765	0.756	-	-	-
Punct.	0.714	0.708	0.737	-	-
Gram.	0.747	0.747	0.769	0.733	-

Table 17–13. Correlations among Diagnostic Categories — Writing/Eng Comp Grades 6–HS

Diagnostic Category	Focus.	Content.	Edit.	Punct.	Gram.
Focus.	-	-	-	-	-
Content.	0.727	-	-	-	-
Edit.	0.725	0.715	-	-	-
Punct.	0.702	0.691	0.714	-	-
Gram.	0.700	0.691	0.712	0.704	-

The correlations in Tables 17–1 through 17–13 are based on the observed diagnostic category scores. These observed-score correlations are weakened by existing measurement error contained within each diagnostic category. As a result, disattenuated correlations could provide an estimate of the relationships among diagnostic categories if there were no measurement error. (An important caveat is explained further below.) The disattenuated correlation coefficients (R_{12}) can be computed by using the formula (Spearman 1904, 1910) below:

$$R_{12} = \frac{r_{12}}{\sqrt{r_{11} r_{22}}},$$

where r_{12} is the observed correlation, and r_{11} and r_{22} are the reliabilities for diagnostic categories 1 and 2. Disattenuated correlations very near 1.00 suggest that the same or very similar constructs are being measured. Values somewhat less than 1.00 suggest that different diagnostic categories are measuring slightly different aspects of the same construct. Values markedly less than 1.00 suggest the diagnostic categories reflect different constructs.

Tables 17–14 through 17–26 show the corresponding disattenuated correlations. Given that none of these diagnostic categories had perfect reliabilities (see Chapter Sixteen), the disattenuated correlations are higher than their observed score counterparts.

Table 17–14. Disattenuated Correlations among Diagnostic Categories — Math Grades 3–5

Diagnostic Category	Numbers.	Alg. Con	Geo.	Meas.
Numbers.	-	-	-	-
Alg. Con.	0.955	-	-	-
Geo.	0.886	0.880	-	-
Meas.	0.946	0.958	0.895	-

Table 17–15. Disattenuated Correlations among Diagnostic Categories — Math Grades 6–HS

Diagnostic Category	Numbers.	Alg. Con	Geo.	Meas.
Numbers.	-	-	-	-
Alg. Con.	0.890	-	-	-
Geo.	0.858	0.853	-	-
Meas.	0.875	0.866	0.852	-

Table 17–16. Disattenuated Correlations among Diagnostic Categories — Algebra I

Diagnostic Category	Operations.	Linear.	Functions.	Data.
Operations.	-	-	-	-
Linear.	0.797	-	-	-
Functions.	0.809	0.852	-	-
Data.	0.789	0.813	0.839	-

Table 17–17. Disattenuated Correlations among Diagnostic Categories — Geometry

Diagnostic Category	Properties.	Congruence.	Coordinate.	Measure.
Properties.	-	-	-	-
Congruence.	0.831	-	-	-
Coordinate.	0.829	0.830	-	-
Measure.	0.841	0.825	0.838	-

Table 17–18. Disattenuated Correlations among Diagnostic Categories — Algebra II

Diagnostic Category	Complex.	Non-Linear.	Functions.	Data.
Complex.	-	-	-	-
Non-Linear.	0.723	-	-	-
Functions.	0.711	0.867	-	-
Data.	0.606	0.820	0.826	-

Table 17–19. Disattenuated Correlations among Diagnostic Categories — Reading Grades 3–5

Diagnostic Category	Key – Lit.	Key – Info.	Craft – Lit.	Craft – Info.	Vocab.
Key – Lit.	-	-	-	-	-
Key – Info.	0.939	-	-	-	-
Craft – Lit.	0.972	0.941	-	-	-
Craft – Info.	0.924	0.941	0.938	-	-
Vocab.	0.948	0.938	0.941	0.939	-

Table 17–20. Disattenuated Correlations among Diagnostic Categories — Reading/Lit Grades 6–HS

Diagnostic Category	Key – Lit.	Key – Info.	Craft – Lit.	Craft – Info.	Vocab.
Key – Lit.	-	-	-	-	-
Key – Info.	0.905	-	-	-	-
Craft – Lit.	0.939	0.917	-	-	-
Craft – Info.	0.906	0.941	0.924	-	-
Vocab.	0.907	0.916	0.921	0.926	-

Table 17–21. Disattenuated Correlations among Diagnostic Categories — Science Grades 3–5

Diagnostic Category	Nature.	Bio.	Phys.	Earth/Space.
Nature.	-	-	-	-
Bio.	0.987	-	-	-
Phys.	0.988	0.980	-	-
Earth/Space.	0.980	0.972	0.974	-

Table 17–22. Disattenuated Correlations among Diagnostic Categories — Science Grades 6–HS

Diagnostic Category	Nature.	Bio.	Phys.	Earth/Space.
Nature.	-	-	-	-
Bio.	0.902	-	-	-
Phys.	0.895	0.890	-	-
Earth/Space.	0.896	0.898	0.890	-

Table 17–23. Disattenuated Correlations among Diagnostic Categories — Biology

Diagnostic Category	Basic.	Bioenerg.	Cell Growth.	Evol./Ecol.
Basic.	-	-	-	-
Bioenerg.	0.890	-	-	-
Cell Growth.	0.881	0.879	-	-
Evol./Ecol.	0.879	0.847	0.874	-

Table 17–24. Disattenuated Correlations among Diagnostic Categories — Chemistry

Diagnostic Category	Matter.	Atomic.	Mole.	Chem.
Matter.	-	-	-	-
Atomic.	0.754	-	-	-
Mole.	0.789	0.882	-	-
Chem.	0.743	0.806	0.818	-

Table 17–25. Disattenuated Correlations among Diagnostic Categories — Writing Grades 3–5

Diagnostic Category	Focus.	Content.	Edit.	Punct.	Gram.
Focus.	-	-	-	-	-
Content.	0.984	-	-	-	-
Edit.	0.973	0.974	-	-	-
Punct.	0.917	0.919	0.961	-	-
Gram.	0.938	0.948	0.981	0.942	-

Table 17–26. Disattenuated Correlations among Diagnostic Categories — Writing/Eng Comp Grades 6–HS

Diagnostic Category	Focus.	Content.	Edit.	Punct.	Gram.
Focus.	-	-	-	-	-
Content.	0.909	-	-	-	-
Edit.	0.908	0.901	-	-	-
Punct.	0.879	0.872	0.903	-	-
Gram.	0.883	0.876	0.905	0.896	-

In reviewing the differences between the simple correlations and the disattenuated ones, it is clear that the impact of the "less than perfect" reliabilities on the disattenuated correlations is large for most of the tests. For example, Science Grades 3–5 found virtually no differences between any pair of disattenuated correlations. This indicates that, for the majority of students, the diagnostic category scores are merely shorter versions of what the total scores are measuring. Note that, while the theoretical maximum for observed correlations is 1.00, disattenuated correlations can exceed this value when high observed correlations are combined with low reliabilities. The other tests' disattenuated correlations are somewhat lower, generally in the range of .82 to .95. The test with the lowest disattenuated correlations is Algebra II, with Complex Numbers showing the most uniqueness.

As a practical consideration, and despite these results, diagnostic category scores for individual students may still provide useful information to the teacher. For example, a student may still have statistically significant differences between pairs of diagnostic scores ("areas of needs" versus "strengths to build on") with large observed scale score differences. The diagnostic reporting suite shows these differences in a graphic that includes the level of precision for each scale score in the form of an "error band." The error band is the scale score ± one conditional standard error. Any two pairs of scores can be interpreted as statistically different if their respective error bands do not overlap. More details about the use and interpretation of error bands may be found in Chapter Fourteen. Additionally, Chapter Fifteen provides summary information about conditional standard errors for each diagnostic category and tables that indicate the incidence of non-overlapping error bands in the 2021–2022 operational testing population.

EXPLORATORY FACTOR ANALYSIS

In order to further explore the internal structure of each CDT, an exploratory factor analysis (EFA) of the diagnostic category scores was conducted. Operational data from the 2021–2022 school year was used to create the observed correlation matrices shown in Tables 17–1 through 17–13. These, in turn, were used in the EFA. In the *Statistical Package for the Social Sciences (SPSS)*, Principal Axis Factor extraction was utilized with an oblique rotation (Promax) of the initial factor solution to improve interpretability. Oblique rotations allow for correlated factors.

Tables 17–27 through 17–39 present the eigenvalues and the explained variance for the extracted factors. Figures 17–1 through 17–13 are scree plot graphs of the eigenvalues against the factor number. In general, the first factor accounts for approximately 76% of the total variance for all CDT tests except Chemistry, while the second factor accounts for approximately 8% of the total variance. For Chemistry, the first factor accounts for 62% of the total variance, while the second factor accounts for 14%. For each CDT, only the first factor had an eigenvalue greater than 1.0, typically suggesting a one-factor solution using the Kaiser criterion.

Table 17–27. Eigenvalues and Explained Variance for Math Grades 3–5 Diagnostic Categories

Factor	Eigenvalue	Percent
1	3.22	80.61
2	0.33	8.22
3	0.23	5.67
4	0.22	5.50

Figure 17–1. Scree Plot for Math Grades 3–5 Diagnostic Categories

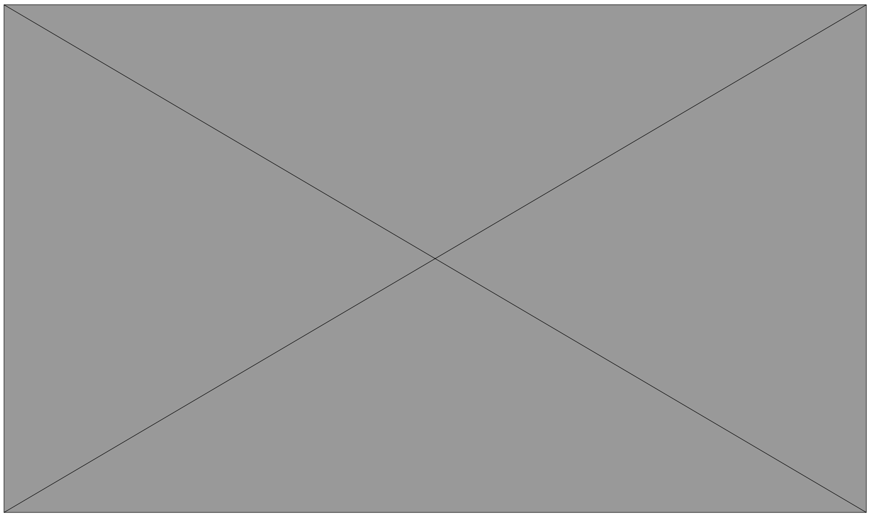


Table 17–28. Eigenvalues and Explained Variance for Math Grades 6–HS Diagnostic Categories

Factor	Eigenvalue	Percent
1	3.11	77.68
2	0.34	8.42
3	0.30	7.39
4	0.26	6.51

Figure 17–2. Scree Plot for Math Grades 6–HS Diagnostic Categories

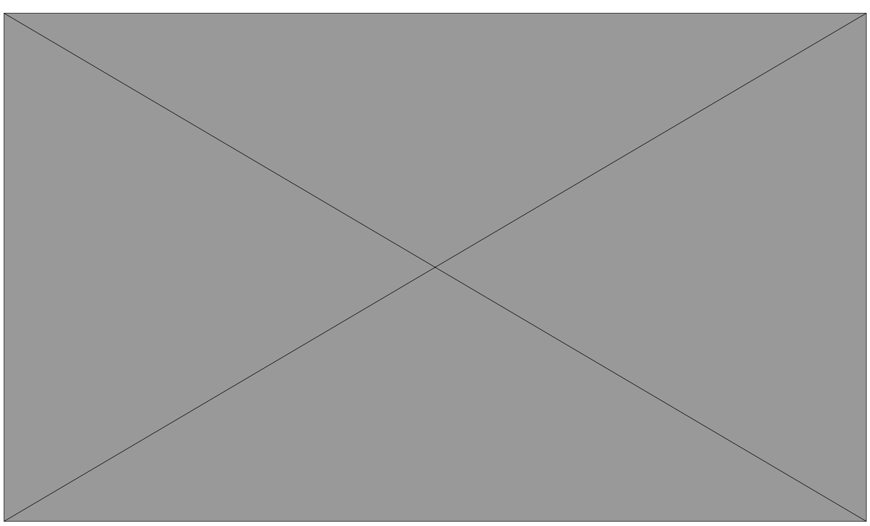


Table 17–29. Eigenvalues and Explained Variance for Algebra I Diagnostic Categories

Factor	Eigenvalue	Percent
1	2.96	73.88
2	0.37	9.21
3	0.34	8.61
4	0.33	8.30

Figure 17–3. Scree Plot for Algebra I Diagnostic Categories

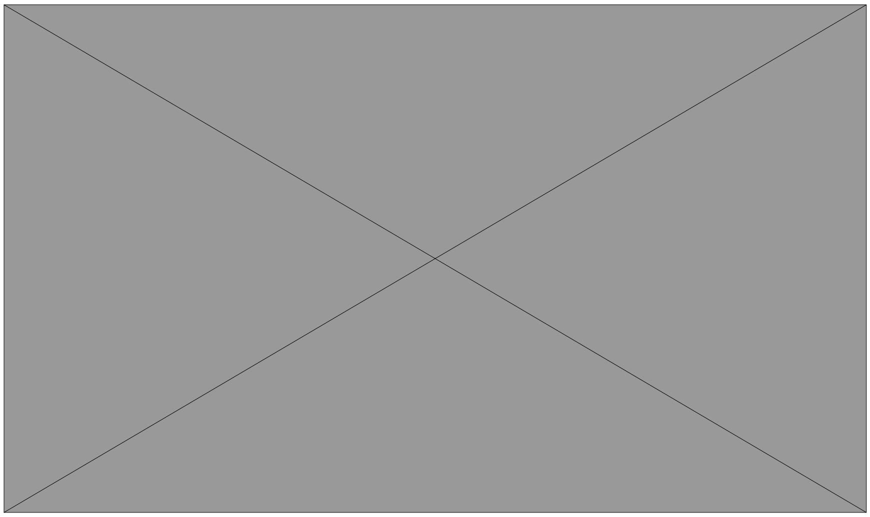


Table 17–30. Eigenvalues and Explained Variance for Geometry Diagnostic Categories

Factor	Eigenvalue	Percent
1	3.03	75.64
2	0.34	8.53
3	0.33	8.14
4	0.31	7.69

Figure 17–4. Scree Plot for Geometry Diagnostic Categories

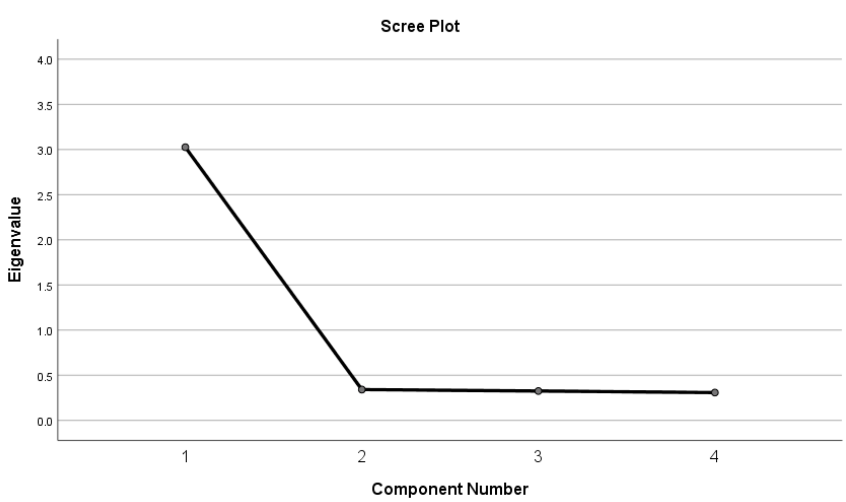


Table 17–31. Eigenvalues and Explained Variance for Algebra II Diagnostic Categories

Factor	Eigenvalue	Percent
1	2.88	72.06
2	0.51	12.84
3	0.32	7.90
4	0.29	7.20

Figure 17–5. Scree Plot for Algebra II Diagnostic Categories

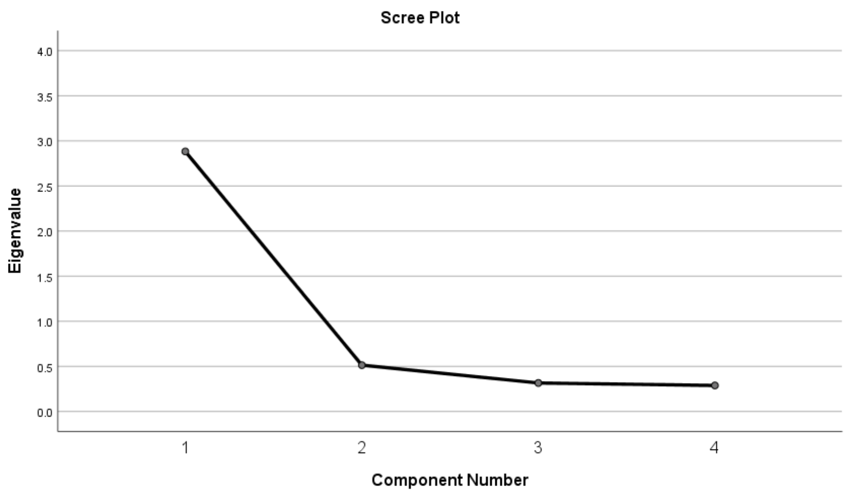


Table 17–32. Eigenvalues and Explained Variance for Reading Grades 3–5 Diagnostic Categories

Factor	Eigenvalue	Percent
1	3.70	73.92
2	0.37	7.31
3	0.33	6.52
4	0.32	6.38
5	0.29	5.86

Figure 17–6. Scree Plot for Reading Grades 3–5 Diagnostic Categories

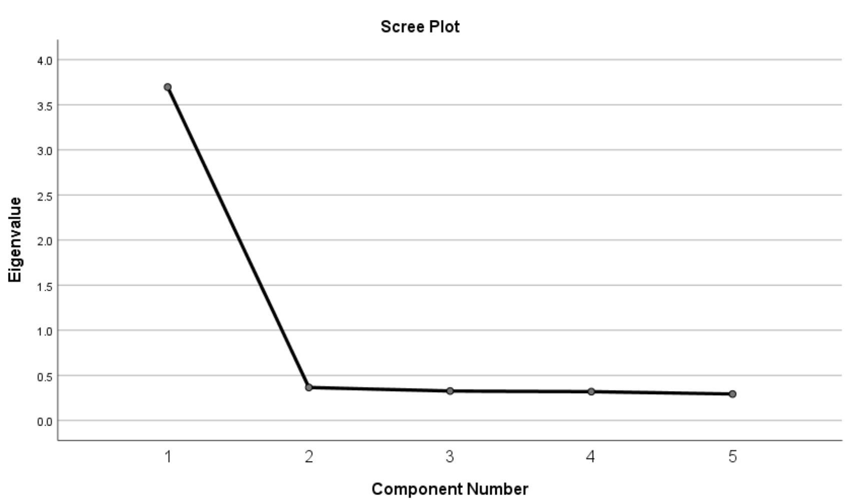


Table 17–33. Eigenvalues and Explained Variance for Reading/Lit Grades 6–HS Diagnostic Categories

Factor	Eigenvalue	Percent
1	3.62	72.47
2	0.38	7.63
3	0.35	7.00
4	0.33	6.61
5	0.31	6.28

Figure 17–7. Scree Plot for Reading/Lit Grades 6–HS Diagnostic Categories

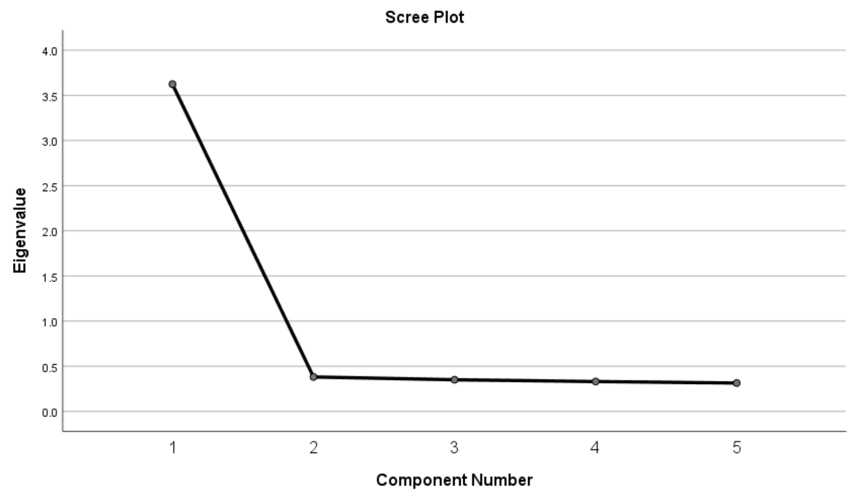


Table 17–34. Eigenvalues and Explained Variance for Science Grades 3–5 Diagnostic Categories

Factor	Eigenvalue	Percent
1	3.28	81.92
2	0.26	6.54
3	0.24	5.96
4	0.22	5.59

Figure 17–8. Scree Plot for Science Grades 3–5 Diagnostic Categories

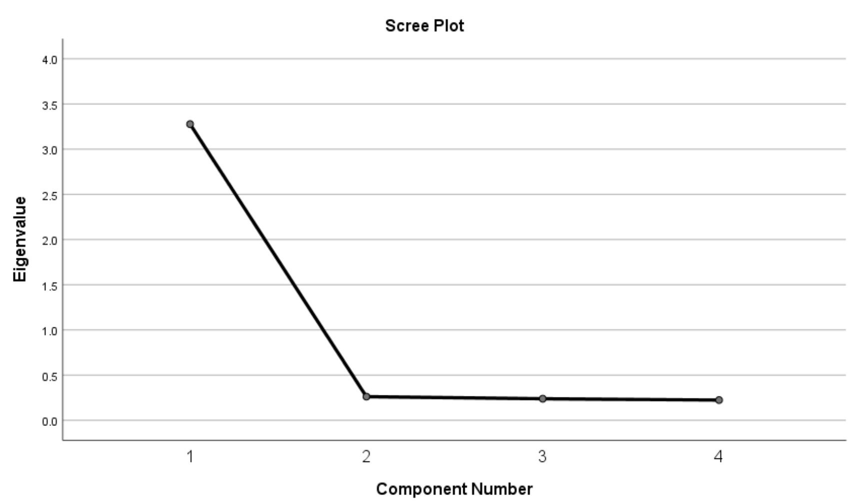


Table 17–35. Eigenvalues and Explained Variance for Science Grades 6–HS Diagnostic Categories

Factor	Eigenvalue	Percent
1	3.04	75.97
2	0.35	8.80
3	0.32	8.06
4	0.29	7.16

Figure 17–9. Scree Plot for Science Grades 6–HS Diagnostic Categories

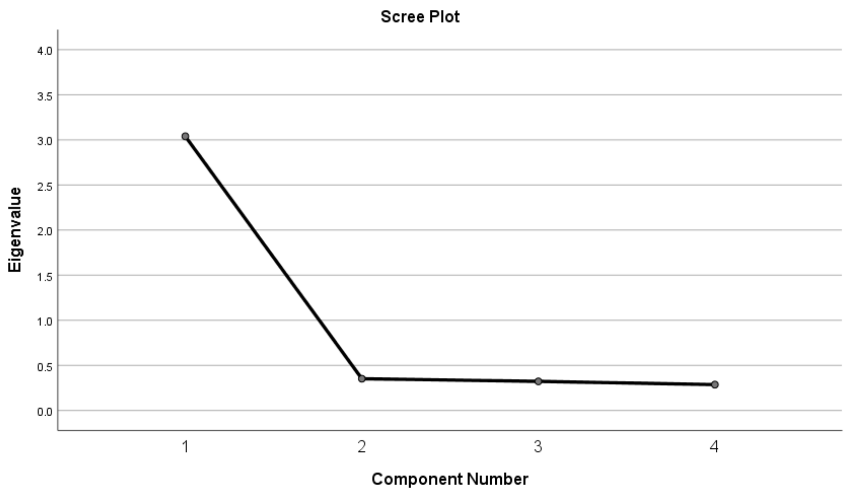


Table 17–36. Eigenvalues and Explained Variance for Biology Diagnostic Categories

Factor	Eigenvalue	Percent
1	2.99	74.69
2	0.38	9.48
3	0.34	8.45
4	0.30	7.38

Figure 17–10. Scree Plot for Biology Diagnostic Categories

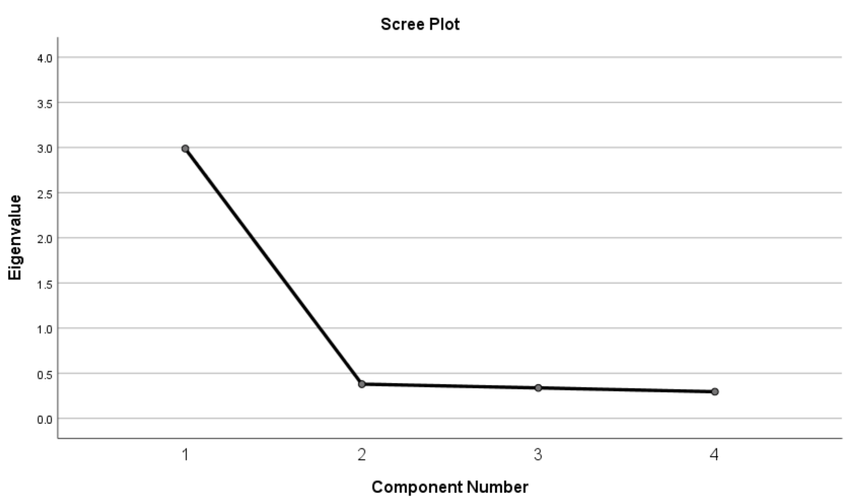


Table 17–37. Eigenvalues and Explained Variance for Chemistry Diagnostic Categories

Factor	Eigenvalue	Percent
1	2.46	61.57
2	0.56	14.10
3	0.52	12.95
4	0.45	11.37

Figure 17–11. Scree Plot for Chemistry Diagnostic Categories

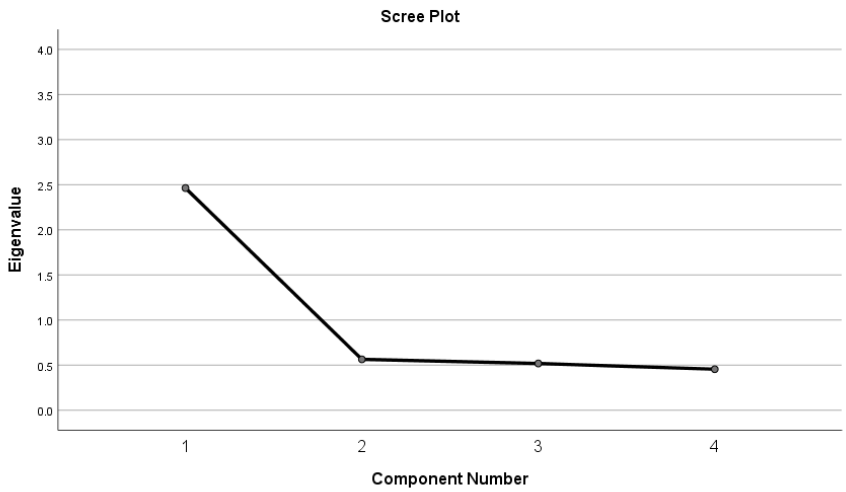


Table 17–38. Eigenvalues and Explained Variance for Writing Grades 3–5 Diagnostic Categories

Factor	Eigenvalue	Percent
1	3.98	79.63
2	0.31	6.22
3	0.26	5.11
4	0.23	4.63
5	0.22	4.41

Figure 17–12. Scree Plot for Writing Grades 3–5 Diagnostic Categories

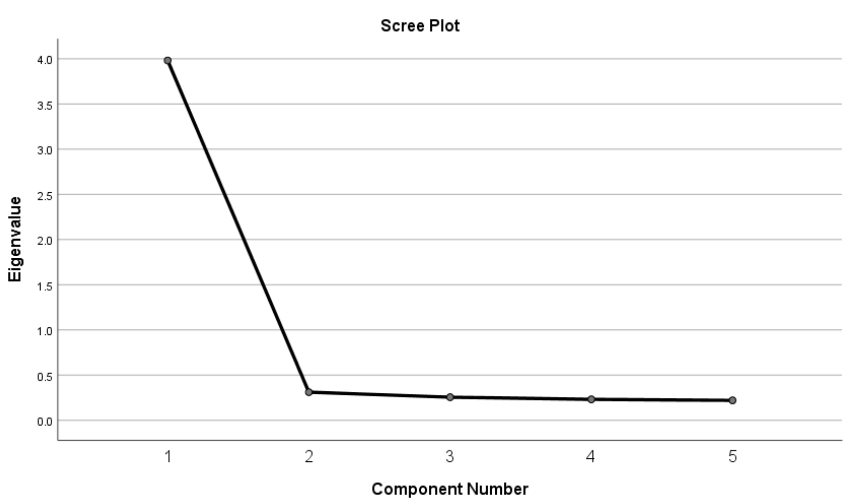
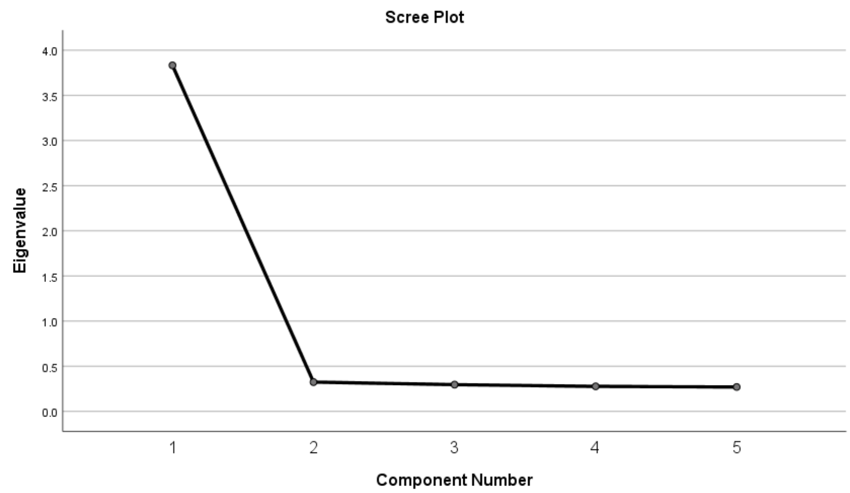


Table 17–39. Eigenvalues and Explained Variance for Writing/Eng Comp Grades 6–HS Diagnostic Categories

Factor	Eigenvalue	Percent
1	3.83	76.65
2	0.32	6.49
3	0.30	5.92
4	0.28	5.54
5	0.27	5.40

Figure 17–13. Scree Plot for Writing/Eng Comp Grades 6–HS Diagnostic Categories



Taken as a whole, the internal structure evidence presented generally indicates that related elements of each of the CDT tests are correlated in the intended manner. This further supports using a total score to report students' performances in the different content areas.

The diagnostic category scores present more of a mixed message. Since the diagnostic categories in each of the CDT tests were designed to measure distinct components, it is reasonable to expect that the diagnostic category correlations should be positive and strong but, ideally, not extremely high. However, the disattenuated correlations imply that some diagnostic categories are essentially measuring the same constructs. While there is content rationale underlying the creation of the diagnostic category scores, the empirical correlations illustrate that caution is required when using these scores when identifying an individual student's areas of need and strengths to build on.

EVIDENCE BASED ON RELATIONSHIPS WITH OTHER VARIABLES

As described in the *Standards* (AERA, APA, & NCME, 2014), ". . . Evidence based on relationships with other variables provides evidence about the degree to which these relationships are consistent with the construct underlying the proposed test score interpretations" (p. 16). This category of evidence refers to "external structure evidence" and has been classified as three types of evidence: *convergent, discriminant*, and *criterion-related*. *Convergent evidence* is provided by relationships among students' performances on different assessments intended to measure a similar construct. *Discriminant evidence* is provided by relationships among students' performances on different tests intended to measure different constructs. *Criterion-related evidence*, either predictive or concurrent, is provided by relationships between students' test scores and their performances on a criterion measure (Cronbach, 1971; Messick, 1989).

Correlations and disattenuated correlations among students' test scores across different CDT content areas provide some discriminant validity evidence. These are provided in Tables 17–40 and 17–41.

Table 17–40a. Correlations among CDT Grades 3–5 Tests

CDT	Math Grades 3–5	Reading Grades 3–5	Science Grades 3–5	Writing Grades 3–5
Math Grades 3–5	-	-	-	-
Reading Grades 3–5	0.773	-	-	-
Science Grades 3–5	0.744	0.764	-	-
Writing Grades 3–5	0.755	0.831	0.804	-

Table 17–40b. Correlations among CDT Tests

CDT	Math Gr 6–HS	Algebra I	Geometry	Algebra II	Read/Lit Gr 6–HS	Science Gr 6–HS	Biology	Chemistry	Writing/ Eng Comp Gr 6–HS
Math Gr 6–HS									
Algebra I	0.764								
Geometry	0.735	0.721							
Algebra II	-	0.712	0.759						
Read/Lit Gr 6–HS	0.720	0.666	0.665	0.660					
Science Gr 6–HS	0.706	0.682	0.694	0.707	0.748				
Biology	0.667	0.634	0.681	0.665	0.729	0.707			
Chemistry	-	0.487	0.634	0.648	0.683	-	0.707		
Writing Gr 6–HS	0.713	0.694	0.671	0.668	0.803	0.731	0.634	0.640	

Table 17–41a. Disattenuated Correlations among CDT Grades 3–5 Tests

CDT	Math Grades 3–5	Reading Grades 3–5	Science Grades 3–5	Writing Grades 3–5
Math Grades 3–5	-	-	-	-
Reading Grades 3–5	0.827	-	-	-
Science Grades 3–5	0.791	0.821	-	-
Writing Grades 3–5	0.798	0.888	0.853	-

Table 17–41b. Disattenuated Correlations among CDT Tests

CDT	Math Gr 6–HS	Algebra I	Geometry	Algebra II	Read/Lit Gr 6–HS	Science Gr 6–HS	Biology	Chemistry	Writing/ Eng Comp Gr 6–HS
Math Gr 6–HS	-	-	-	-	-	-	-	-	-
Algebra I	0.816	-	-	-	-	-	-	-	-
Geometry	0.783	0.770	-	-	-	-	-	-	-
Algebra II	-	0.760	0.808	-	-	-	-	-	-
Read/Lit Gr 6–HS	0.772	0.717	0.714	0.708	-	-	-	-	-
Science Gr 6–HS	0.757	0.734	0.745	0.758	0.809	-	-	-	-
Biology	0.716	0.683	0.732	0.713	0.789	0.765	-	-	-
Chemistry	-	0.542	0.705	0.719	0.764	-	0.791	-	-
Writing Gr 6–HS	0.755	0.738	0.712	0.708	0.858	0.781	0.678	0.707	-

Each CDT test measures a different construct, so the correlations among them were not expected to be extremely high. The values in the tables are consistent with this expectation. Correlations among the CDT tests ranged from 0.487 to 0.803. Correlations across tests within a content area tend to be more highly correlated than across content areas. For example, the correlation between Algebra I and Geometry is 0.721, whereas the correlation between Algebra I and Biology is 0.634.

External evidence for the CDT is examined by using students' scores on the 2022 Pennsylvania System of School Assessment (PSSA) and/or 2022 Keystone Exams as external criteria. For each content area, CDT results from the 2021–2022 school year were matched to spring 2022 PSSA in the corresponding content area using the PA secure ID. Similarly, CDT tests in Algebra I, Biology, and Reading/Literature were matched to corresponding spring 2022 Keystone Exams. The correlations between students' total scale scores on the CDT and PSSA or Keystone are calculated as one piece of external evidence. Table 17–42 summarizes the sample sizes and correlations.

Table 17–42. Correlation between CDT and PSSA or Keystone Exams Scores

Student Grade	CDT	PSSA or Keystone Test	*N*	Correlation of Total Scale Scores
3	Math Grades 3–5	PSSA Math Grade 3	14,282	0.805
4	Math Grades 3–5	PSSA Math Grade 4	15,278	0.819
5	Math Grades 3–5	PSSA Math Grade 5	18,284	0.788
6	Math Grades 6–HS	PSSA Math Grade 6	21,591	0.823
7	Math Grades 6–HS	PSSA Math Grade 7	24,310	0.796
8	Math Grades 6–HS	PSSA Math Grade 8	21,053	0.769
3	Reading Grades 3–5	PSSA ELA Grade 3	13,401	0.804
4	Reading Grades 3–5	PSSA ELA Grade 4	14,956	0.807
5	Reading Grades 3–5	PSSA ELA Grade 5	16,985	0.815
6	Reading/Lit Grades 6–HS	PSSA ELA Grade 6	17,724	0.788
7	Reading/Lit Grades 6–HS	PSSA ELA Grade 7	20,025	0.777
8	Reading/Lit Grades 6–HS	PSSA ELA Grade 8	19,466	0.756
4	Science Grades 3–5	PSSA Science Grade 4	8,772	0.790
8	Science Grades 6–HS	PSSA Science Grade 8	21,985	0.778
3	Writing Grades 3–5	PSSA ELA Grade 3	1,833	0.787
4	Writing Grades 3–5	PSSA ELA Grade 4	2,233	0.785
5	Writing Grades 3–5	PSSA ELA Grade 5	2,844	0.774
6	Writing/Eng Comp Gr 6–HS	PSSA ELA Grade 6	4,144	0.785
7	Writing/Eng Comp Gr 6–HS	PSSA ELA Grade 7	5,827	0.771
8	Writing/Eng Comp Gr 6–HS	PSSA ELA Grade 8	5,782	0.741
6–12	Algebra I	Keystone Algebra I	27,565	0.744
6–12	Biology	Keystone Biology	37,627	0.801
6–12	Reading/Literature	Keystone Literature	30,898	0.722

These results provide external evidence in support of CDT as a valid measure of students' achievement.

The collection of external evidence related to the CDT is an ongoing process. As more CDT data become available, other criterion-related evidence will be evaluated. In addition to examining the relationship between CDT and PSSA or Keystone Exams, other criterion variables such as Scholastic Aptitude Test (SAT) scores, American College Test (ACT) scores, or student grade point average (GPA) may be considered.

EVIDENCE BASED ON CONSEQUENCES OF TESTS

According to the *Standards* (AERA, APA, & NCME, 2014), evidence of the consequences of implementing an assessment program is an additional source of validity information. Both positive and negative (intended and unintended) consequences of score-based inferences must be investigated to fully evaluate the pool of validity evidence.

Lane and Stone (2002) summarized the general *intended* consequences for state assessments and accountability programs:

- Student, teacher, and administrator motivation and effort
- Curriculum and instruction practices (including content and strategies)
- Improved learning for all students
- Content and format of classroom assessments
- Professional development support
- Use and nature of test preparation activities
- Student, teacher, administrator, and public awareness and beliefs about the assessment, criteria for judging performance, and the use of assessment results

Evidence for the improvement of student learning can be seen by looking at the changes in scale scores for students who took the same CDT test multiple times. Table 17–43 below summarizes scale score changes between the first and last administrations of the CDT.

Table 17–43. Summary of Scale Score Changes between CDT Administrations

CDT	*N*	Minimum	Q1	Median	Mean	Q3	Maximum
Math Grades 3–5	38,911	-594	24	83	85.37	146	743
Math Grades 6–HS	52,572	-579	-13	48	44.79	108	642
Algebra I	25,340	-589	-33	37	31.33	103	754
Geometry	3,074	-565	-16	57	45.24	121	698
Algebra II	2,953	-554	-20	53	40.78	120	660
Reading Grades 3–5	36,988	-589	-20	39	39.12	99	543
Reading/Lit Grades 6–HS	80,112	-646	-55	5	1.96	63	532
Science Grades 3–5	11,046	-520	-14	45	46.49	104	595
Science Grades 6–HS	32,295	-568	-40	19	15.96	74	694
Biology	29,410	-473	-14	54	48.88	116	630
Chemistry	2,287	-403	-37	33	22.85	92	581
Writing Grades 3–5	5,086	-444	-16	41	40.46	96	489
Writing/Eng Comp Gr 6–HS	13,305	-607	-47	14	8.65	72	530

Lane and Stone (2002) also summarized the possible *unintended* outcomes:

- Narrowing of curriculum and instruction to focus only on the specific standards assessed and ignoring the broader construct reflected in the specified standards
- Use of test preparation materials that are closely linked to the assessment without making changes to instruction
- Use of unethical test preparation materials or administration procedures
- Differential performance gains for subgroups of students
- Inappropriate or unfair uses of test scores, such as questionable practices in reassignment of teachers or principals
- For some students, decreased confidence and motivation to learn and to perform well on the assessment because of past experiences with assessments

As noted above, one important piece of consequential evidence pertains to the use of assessment results. As shown in Chapter Fourteen, CDT offers a dynamic suite of reports. The extent to which various groups of users (e.g., students and teachers) interpret these reports appropriately affects the validity of subsequent uses of these results. As noted in Chapter Fourteen, there are report training scenarios for each content area. The intent is that the scenarios will help users avoid unintended uses and interpretations of the CDT results.

EVIDENCE RELATED TO USE OF THE RASCH MODEL

Since the Rasch model is the basis of all calibration, scaling, and equating analyses associated with the CDT, the validity of the inferences from these results depends on the degree to which the assumptions of the model are met, as well as the fit between the model and the test data. As discussed in Chapter Eight, the underlying assumptions of Rasch models were essentially met for all the CDT data, indicating the appropriateness of using Rasch models to analyze the CDT data.

VALIDITY EVIDENCE SUMMARY

Validity evidence related to test content was reviewed earlier in this chapter. On the whole, the early chapters of this technical report show that a strong link can be established between each CDT item and its associated Eligible Content. Detailed information regarding educator reviews are presented in Chapter Six.

Diagnostic category score intercorrelations were also presented in this chapter. They provide some favorable evidence regarding the internal relationships between the tests' components.

Validity of score inferences is bolstered when test scores are consistent. Here, the reliabilities of the total test scores (presented in Chapter Sixteen) were very good, with many in the low 0.90s.

Reported in Chapter Six, differential item functioning (DIF) with respect to gender and ethnicity helps address construct-irrelevant variance, which represents an important threat to the validity of inferences made from achievement test scores. As noted in that chapter, field-test items are screened and reviewed for DIF. Only items approved by teacher committees are eligible for operational use.

CHAPTER EIGHTEEN: PARAMETER STABILITY

The Classroom Diagnostic Tools (CDT) features a number of tests. Tests in Mathematics, Algebra I, Geometry, and Algebra II have been available since October 2010 for students in grades 6 and above. Tests in Reading/ Literature, Science, Biology, and Chemistry have been available since April 2011 for students in grades 6 and above. Tests in Writing /English Composition have been available since October 2011 for students in grades 6 and above. Tests in Mathematics, Reading, Science, and Writing have been available since April 2014 for students in grades 3 through 5. During the 2020–2021 school year, CAT item selection and Rasch ability estimates were based on initial item parameters estimated from the stand-alone and embedded field-test events and vertical linking (see Chapter Eight and Chapter Nine for details). The only exceptions were 113 items in the mathematics content area that had parameters re-estimated following the 2010–2011 school year and 74 items in the science content area that had parameters re-estimated following the 2011–2012 school year. Following the 2021–2022 school year, item parameter stability was checked for all items in the banks.

METHODOLOGY

In the first two years of CDT, four separate methods were investigated to evaluate the stability of the item parameters in the CDT operational administration

1. Calibrate the entire bank within a content area in a single concurrent calibration. Do not anchor item parameters on banked values. Compare new parameter estimates to the banked values.
2. Calibrate the entire bank within a content area in a single concurrent calibration. Anchor item parameters on banked values. Examine displacements.
3. Calibrate each grade/course level item with students in that grade/course. Do not anchor item parameters on banked values. Compare new parameter estimates to the banked values.
4. Calibrate each grade/course level item with students in that grade/course. Anchor item parameters on banked values. Examine displacements.

As noted in Chapter Twelve, CDT tests are pre-equated. Immediate score reports are based on banked item parameters. Therefore, this chapter focuses on anchored calibrations and examination of displacement values to evaluate item parameter stability[1].

ANCHORED CONCURRENT CALIBRATION WITHIN CONTENT AREA ACROSS GRADES/ COURSES

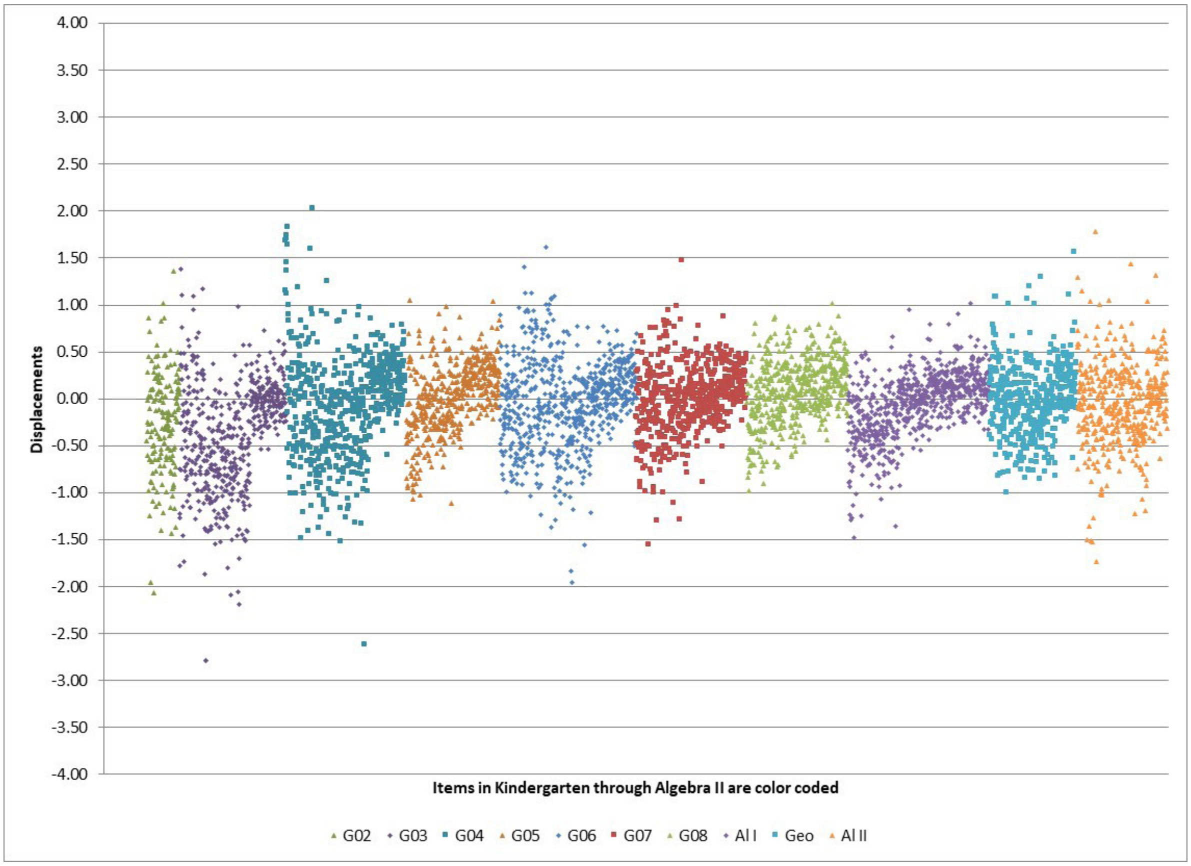
One method used to evaluate the stability of the item parameters in the operational administration was to calibrate the entire bank within a content area anchoring on the banked item parameters and examine the displacements. For each item, the displacement value is the size of the change in the parameter estimate that would be estimated if the parameter for the item was unanchored and all other parameters were anchored at their current value. Given that the banked values were developed into a single, vertical scale, all items within a content area were calibrated in a single concurrent calibration using WINSTEPS software version 3.71 (Linacre, 2009).

MATHEMATICS

Figure 18–1 shows the displacements from a concurrent anchored calibration of all mathematics items using the operational data set. Items are color-coded by grade/course.

[1] For results of all four methods for the 2011–2012 school year, see Chapter Eighteen of the 2011–2012 technical report.

Figure 18–1. Anchored Calibration Displacements — All Items



Note: Many kindergarten and grade 1 items were not estimated by WINSTEPS software due to insufficient counts.

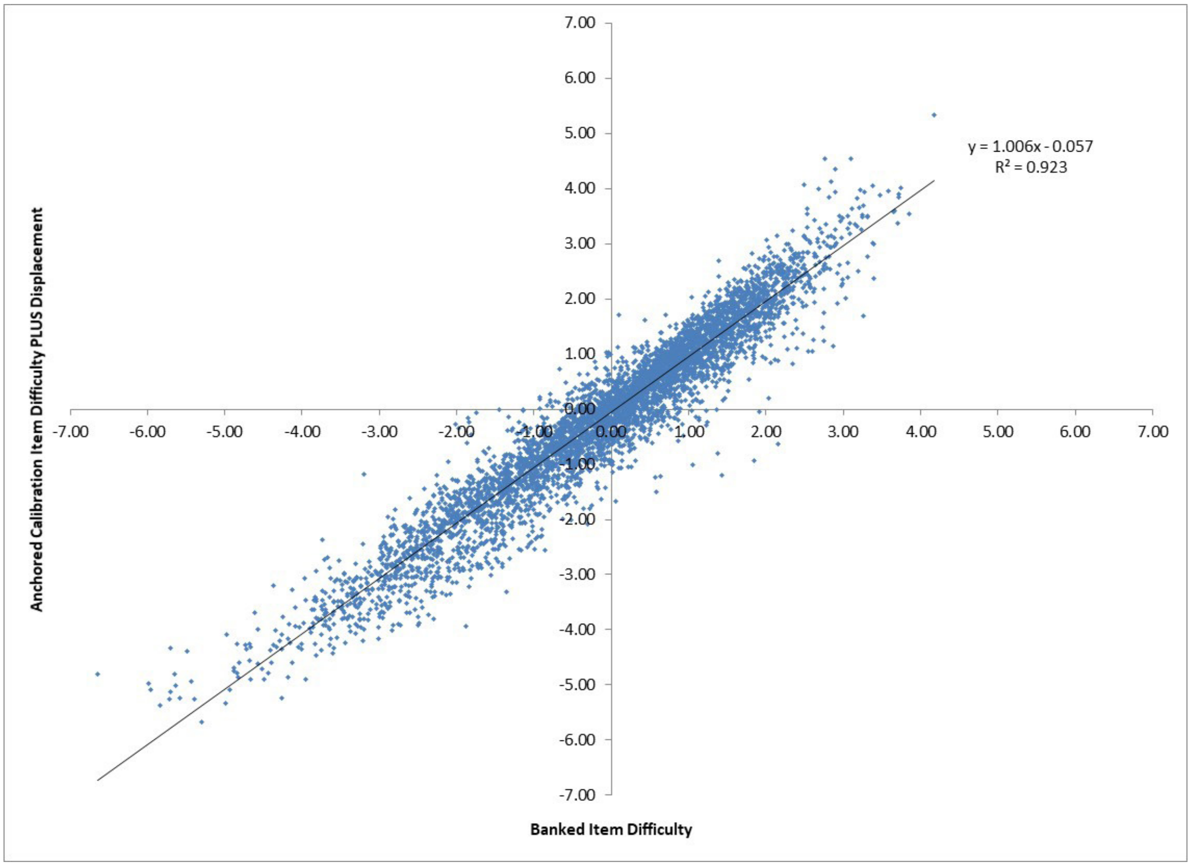
Table 18–1 summarizes the data in Figure 18–1. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Seventy-seven percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–1).

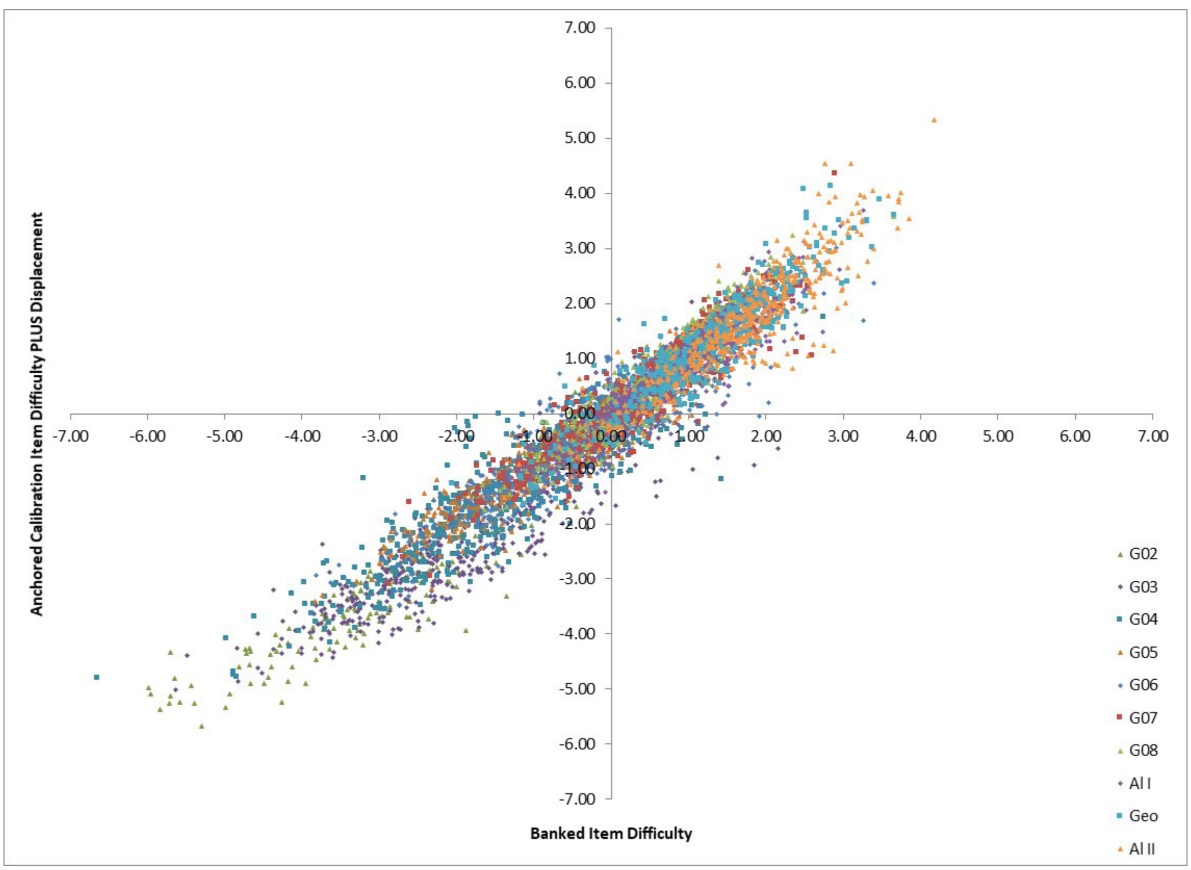
Table 18–1. Number of Mathematics Items by Grade/Course and Displacement Interval

Interval	K	G01	G02	G03	G04	G05	G06	G07	G08	ALI	GEO	ALII	Total
Disp. ≤ -1.0	0	0	13	74	27	3	13	5	0	9	1	12	157
-1.0 < Disp. ≤ -0.9	0	0	8	21	8	6	9	4	2	5	0	3	66
-0.9 < Disp. ≤ -0.8	0	0	2	24	13	4	14	2	1	6	5	3	74
-0.8 < Disp. ≤ -0.7	0	0	9	32	24	7	16	6	7	8	8	12	129
-0.7 < Disp. ≤ -0.6	0	0	12	24	20	6	22	14	8	17	16	11	150
-0.6 < Disp. ≤ -0.5	0	0	11	26	37	9	31	23	10	22	14	11	194
-0.5 < Disp. ≤ -0.4	0	0	7	22	28	19	30	17	10	31	19	27	210
-0.4 < Disp. ≤ -0.3	0	0	12	32	26	22	30	32	24	54	27	38	297
-0.3 < Disp. ≤ -0.2	0	0	12	28	30	39	51	43	24	43	35	40	345
-0.2 < Disp. ≤ -0.1	0	0	13	37	34	36	53	51	44	62	39	40	409
-0.1 < Disp. ≤ 0.0	0	0	8	52	54	49	56	54	54	81	52	48	508
0.0 < Disp. ≤ 0.1	0	0	14	55	58	49	76	79	58	102	45	37	573
0.1 < Disp. ≤ 0.2	0	0	10	24	45	55	73	56	59	106	42	49	519
0.2 < Disp. ≤ 0.3	0	0	9	21	54	51	51	51	56	67	35	37	432
0.3 < Disp. ≤ 0.4	0	0	6	17	46	41	43	34	51	35	34	16	323
0.4 < Disp. ≤ 0.5	0	0	7	12	22	31	36	36	33	24	26	14	241
0.5 < Disp. ≤ 0.6	0	0	2	5	17	15	18	14	20	8	9	18	126
0.6 < Disp. ≤ 0.7	0	0	0	3	14	9	11	6	18	5	5	9	80
0.7 < Disp. ≤ 0.8	0	0	1	3	5	4	18	7	8	2	3	5	56
0.8 < Disp. ≤ 0.9	0	0	3	0	9	2	6	4	4	0	1	2	31
0.9 < Disp. ≤ 1.0	0	0	0	2	5	2	7	2	0	2	0	0	20
1.0 < Disp.	0	0	2	4	13	2	9	1	1	1	9	9	51
TOTAL	0	0	161	518	589	461	673	541	492	690	425	441	4991

Figure 18–2 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored concurrent calibration of operational data for the mathematics item bank. A line of best fit is included in the upper plot. If item difficulties from the operational calibration are close to the banked values, the line will approach an intercept of zero and a slope of one. The lower plot displays the same data as the upper, but color codes items by grade/course in an attempt to lend insight into the possible causes for the deviations.

Figure 18–2. Mathematics Banked Item Parameters vs. Anchored Calibration — All Items





Based on Figure 18–2, one can see that there are a number of items with operational estimates that differ from their banked values. Some of these are in kindergarten through grade 2. Recall that the operational CDT is available to students in grade 3 and above. While items were developed to sample content in kindergarten through grade 2 to provide better diagnostic information for lower-performing students, the data from the operational administration did not include students below grade 3. To investigate whether this had an impact on the stability of the item parameter estimates, a concurrent anchored calibration of all items in grade 3 and above was run.

Figure 18–3 and Table 18–2 summarize the displacements from a concurrent anchored calibration of all items in grade 3 and above. Seventy-eight percent of the items in the calibration have displacement less than 0.5 in magnitude (gray shaded in Table 18–2). Figure 18–4 shows banked item difficulties plotted against the item difficulties plus displacement. Again, a line of best fit is included in the upper plot.

Figure 18–3. Mathematics Anchored Calibration Displacements — All Items in Grade 3 and Above

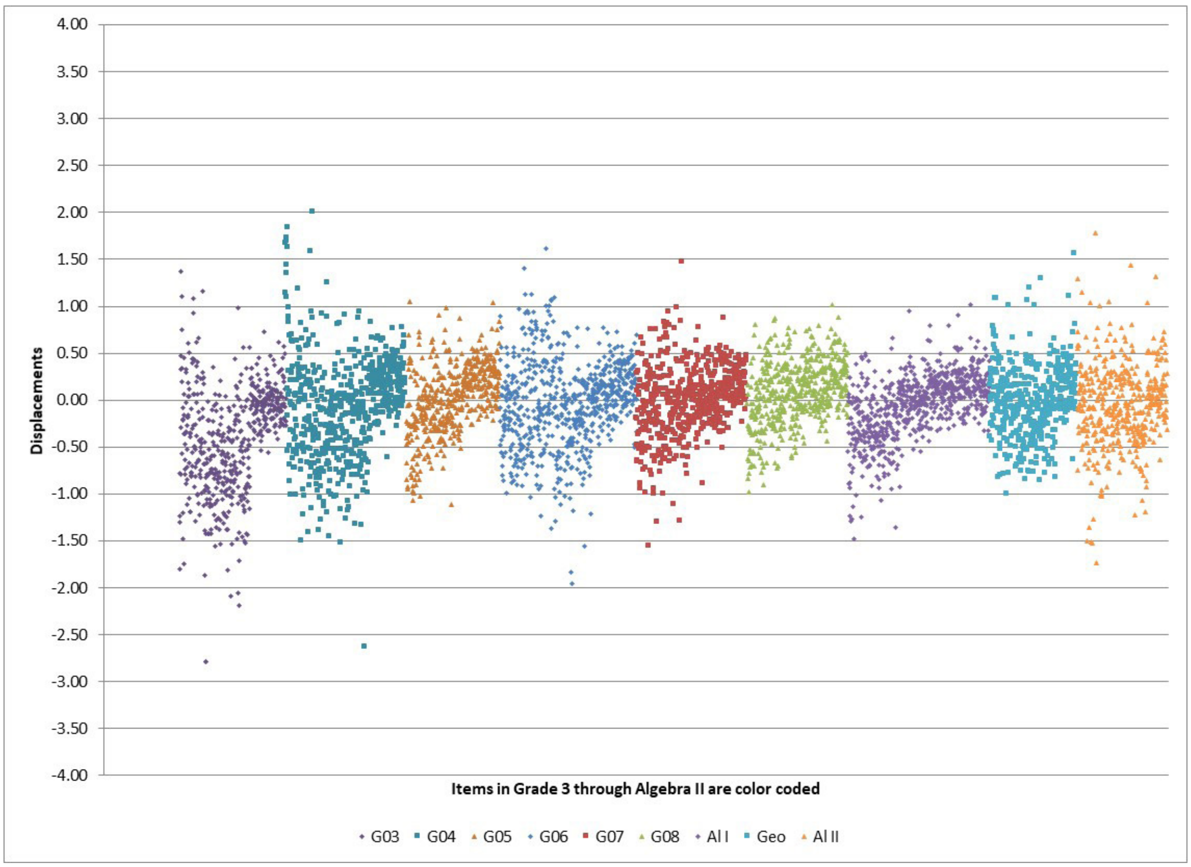
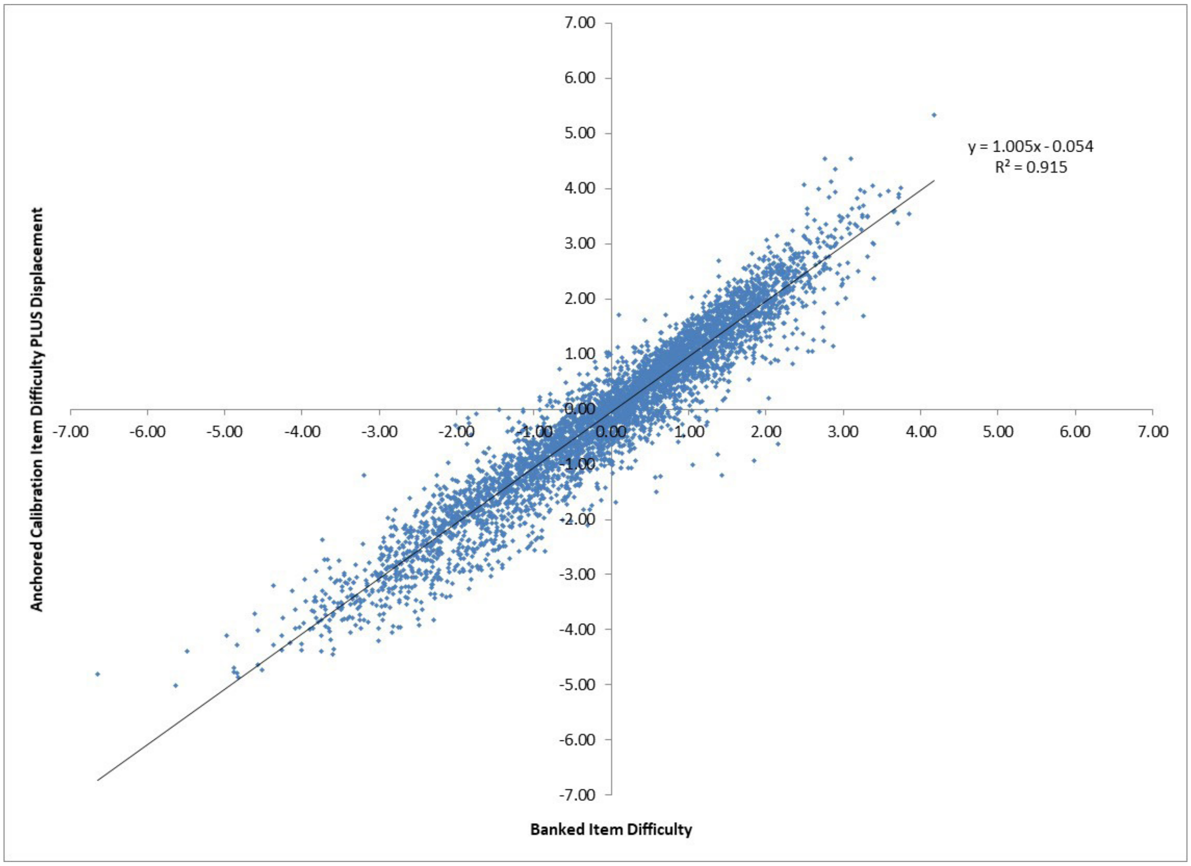
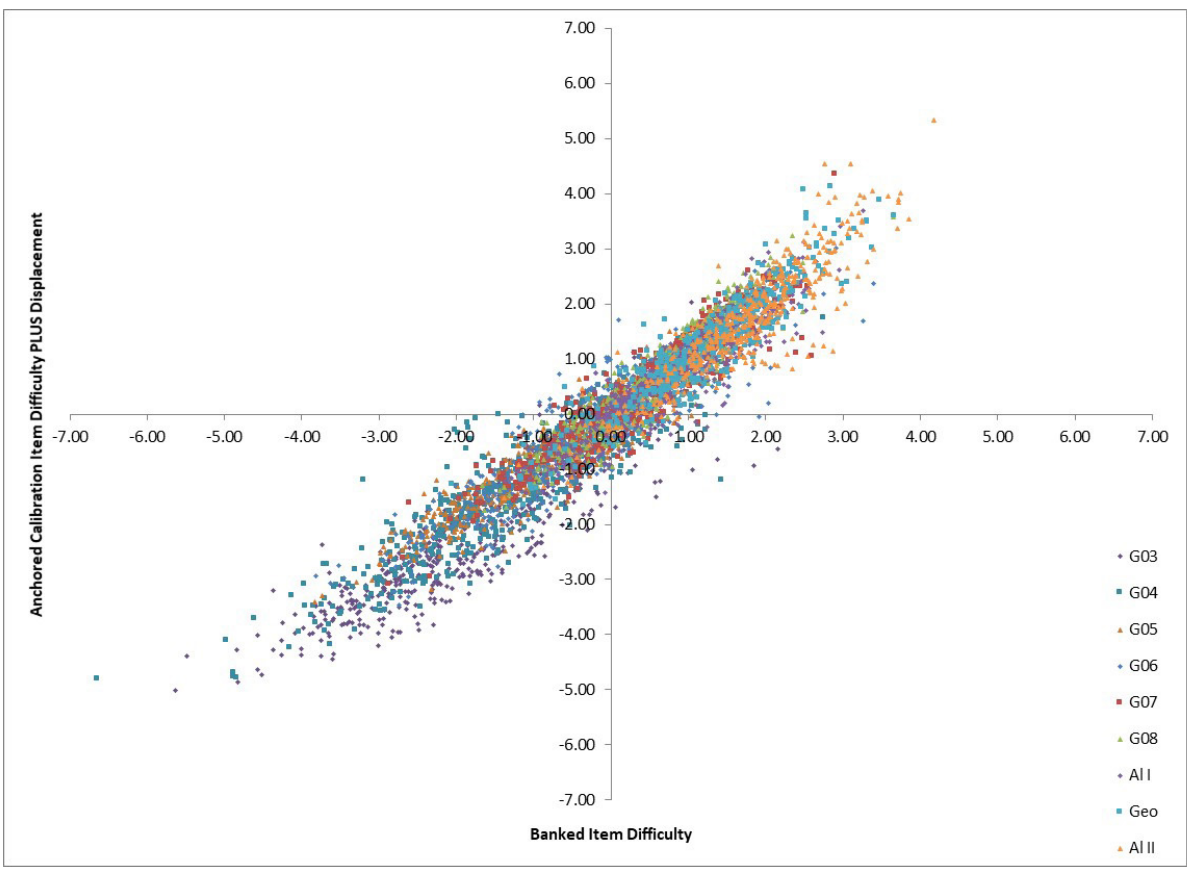


Table 18–2. Number of Mathematics Items by Grade/Course and Displacement Interval

Interval	G03	G04	G05	G06	G07	G08	ALI	GEO	ALII	Total
Disp. ≤ -1.0	78	27	3	13	5	0	9	1	12	148
-1.0 < Disp. ≤ -0.9	20	8	6	9	4	2	5	0	3	57
-0.9 < Disp. ≤ -0.8	26	14	4	14	2	1	6	5	3	75
-0.8 < Disp. ≤ -0.7	30	23	7	16	6	7	8	8	12	117
-0.7 < Disp. ≤ -0.6	25	23	6	22	14	8	17	16	11	142
-0.6 < Disp. ≤ -0.5	22	36	9	31	23	10	22	14	11	178
-0.5 < Disp. ≤ -0.4	29	29	19	30	17	10	31	19	27	211
-0.4 < Disp. ≤ -0.3	31	25	22	30	32	24	54	27	38	283
-0.3 < Disp. ≤ -0.2	39	30	39	51	43	24	43	35	40	344
-0.2 < Disp. ≤ -0.1	31	37	36	53	51	44	62	39	40	393
-0.1 < Disp. ≤ 0.0	57	55	49	56	54	54	81	52	48	506
0.0 < Disp. ≤ 0.1	46	55	49	76	79	58	102	45	37	547
0.1 < Disp. ≤ 0.2	26	46	55	73	56	59	106	42	49	512
0.2 < Disp. ≤ 0.3	16	55	51	51	51	56	67	35	37	419
0.3 < Disp. ≤ 0.4	14	44	41	43	34	51	35	34	16	312
0.4 < Disp. ≤ 0.5	12	20	31	36	36	33	24	26	14	232
0.5 < Disp. ≤ 0.6	4	16	15	18	14	20	8	9	18	122
0.6 < Disp. ≤ 0.7	4	16	9	11	6	18	5	5	9	83
0.7 < Disp. ≤ 0.8	2	3	4	18	7	8	2	3	5	52
0.8 < Disp. ≤ 0.9	0	9	2	6	4	4	0	1	2	28
0.9 < Disp. ≤ 1.0	2	5	2	7	2	0	2	0	0	20
1.0 < Disp.	4	13	2	9	1	1	1	9	9	49
TOTAL	518	589	461	673	541	492	690	425	441	4830

Figure 18–4. Mathematics Banked Item Parameters vs. Anchored Calibration — All Items in Grade 3 and Above





It is evident from this series of plots that the item parameter estimates are reasonably stable for the items in grade 3 and above.

For both of the anchored calibrations described in this section, banked item parameters were compared to the banked item parameters plus the displacements by calculating a robust Z statistic for each item pairing. If item difficulties from the operational calibration are close to the banked values, the correlation will be high and the additive constant near zero. Table 18–3 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in each of the calibrations.

Table 18–3. Summary of Robust Z across Anchored Calibrations in Mathematics

Grade/ Course	Cal 1: Number of Items	Cal 1: Number of Items with ABS(Z) > 1.645	Cal 1: Percent of Items with ABS(Z) > 1.645	Cal 2: Number of Items	Cal 2: Number of Items with ABS(Z) > 1.645	Cal 2: Percent of Items with ABS(Z) > 1.645
Kindergarten	0	0	N/A	0	0	N/A
Grade 1	0	0	N/A	0	0	N/A
Grade 2	161	40	25%	0	0	N/A
Grade 3	518	171	33%	518	177	34%
Grade 4	589	124	21%	589	127	22%
Grade 5	461	39	8%	461	39	8%
Grade 6	673	106	16%	673	107	16%
Grade 7	541	41	8%	541	41	8%
Grade 8	492	36	7%	492	36	7%
Algebra I	690	41	6%	690	44	6%
Geometry	425	39	9%	425	39	9%
Algebra II	441	58	13%	441	60	14%
Total	4991	695	14%	4830	670	14%
	Correlation = 0.961			Correlation = 0.957		
	Additive Constant = -0.058			Additive Constant = -0.054		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, in calibration 2, all items with absolute displacement greater than 0.648 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.639 to 0.648, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.639 have absolute value of robust Z greater than 1.645.

READING/LITERATURE

Figure 18–5 shows the displacements from a concurrent anchored calibration of all reading items using the operational data set. Items are color-coded by grade/course.

Figure 18–5. Reading Anchored Calibration Displacements — All Items

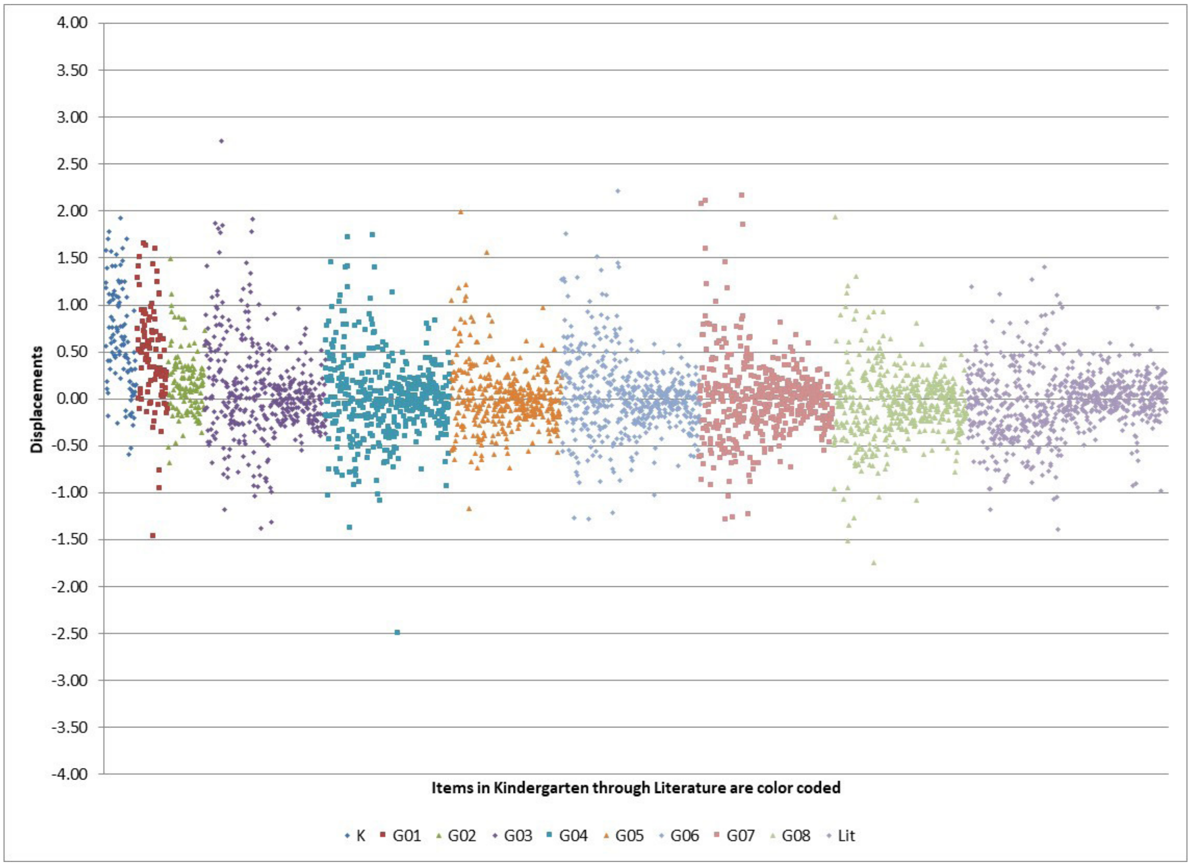


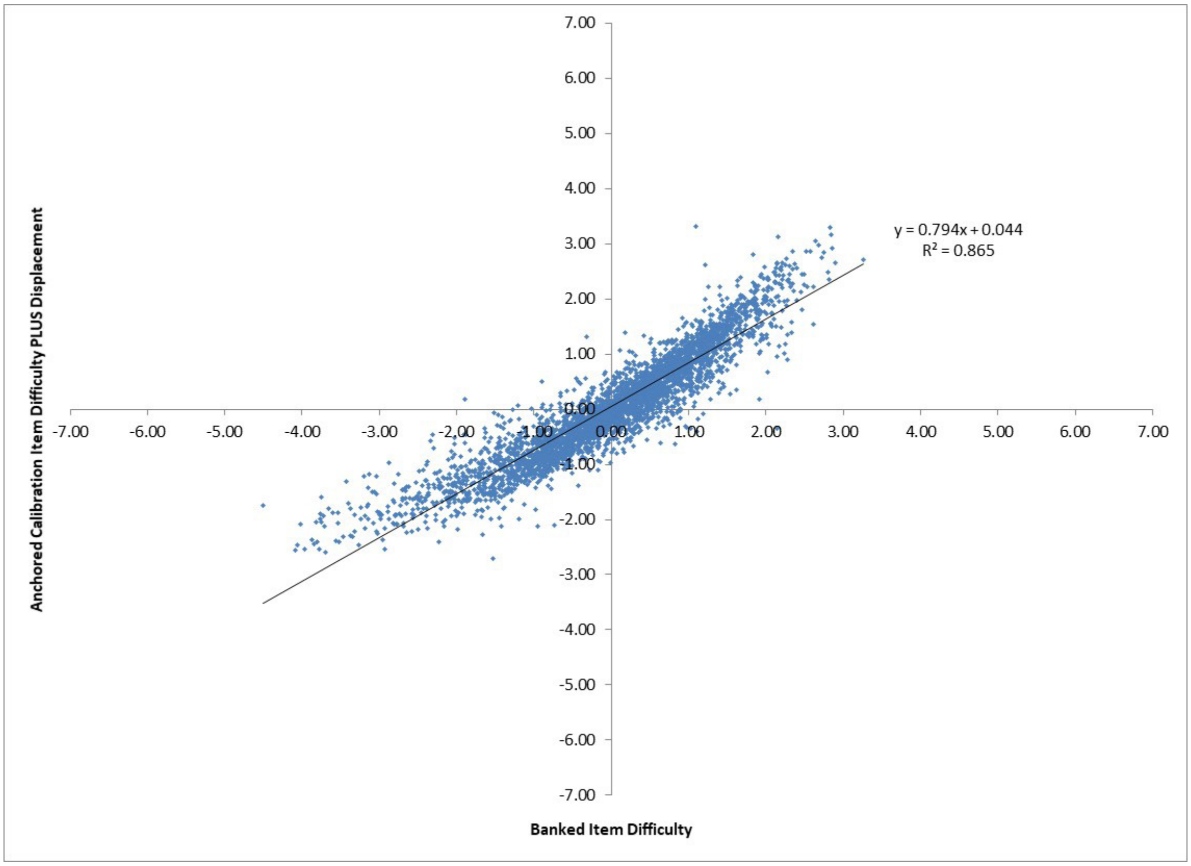
Table 18–4 summarizes the data in Figure 18–5. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-two percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–4).

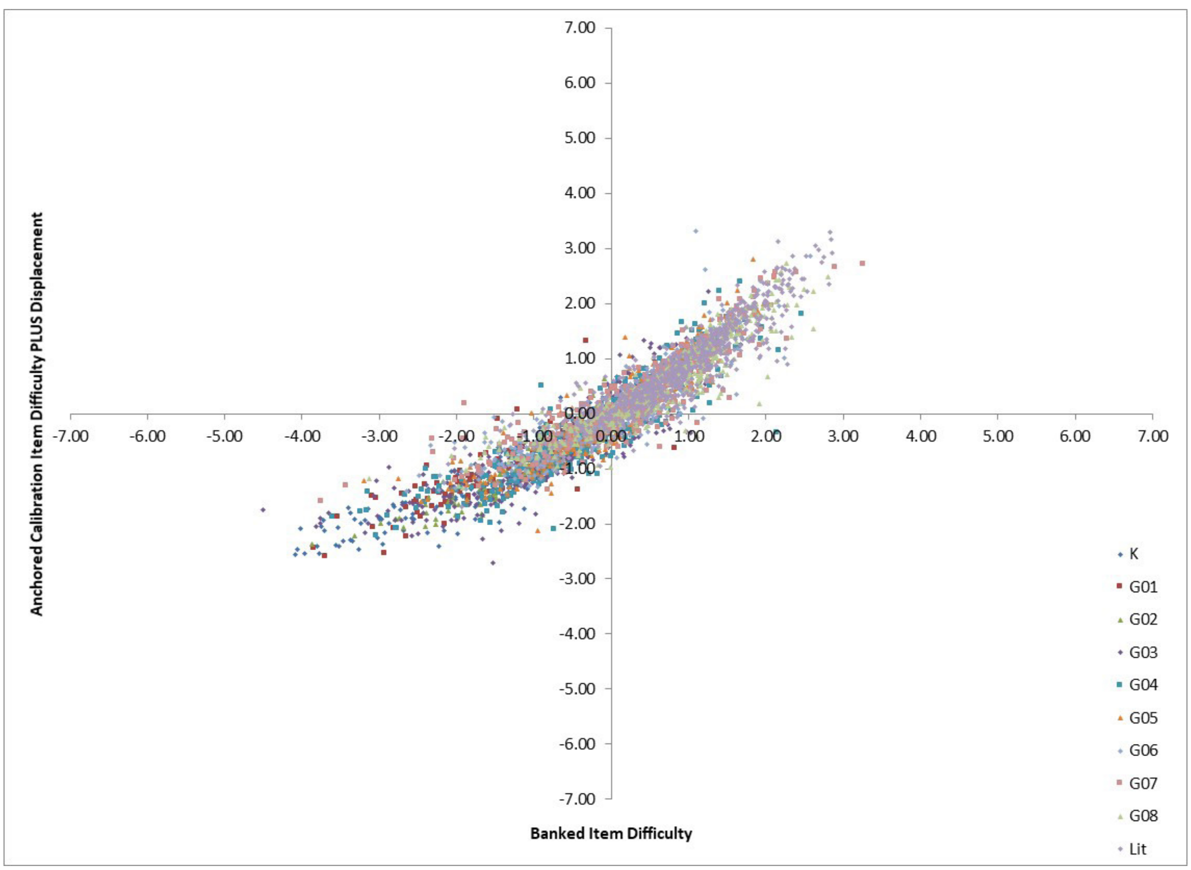
Table 18–4. Number of Reading Items by Grade/Course and Displacement Interval

Interval	K	G01	G02	G03	G04	G05	G06	G07	G08	LIT	Total
Disp. ≤ -1.0	0	1	0	4	5	1	4	4	7	4	30
-1.0 < Disp. ≤ -0.9	0	1	0	4	2	0	0	1	2	5	15
-0.9 < Disp. ≤ -0.8	0	0	0	7	4	0	4	4	0	6	25
-0.8 < Disp. ≤ -0.7	0	1	0	4	8	2	5	4	8	10	42
-0.7 < Disp. ≤ -0.6	0	0	1	6	10	4	10	10	9	14	64
-0.6 < Disp. ≤ -0.5	2	0	1	4	13	10	11	15	19	13	88
-0.5 < Disp. ≤ -0.4	0	0	1	17	19	12	15	21	17	37	139
-0.4 < Disp. ≤ -0.3	0	2	2	20	20	22	24	24	39	38	191
-0.3 < Disp. ≤ -0.2	3	1	5	47	37	26	43	47	53	68	330
-0.2 < Disp. ≤ -0.1	6	6	17	46	48	70	49	50	54	76	422
-0.1 < Disp. ≤ 0.0	1	7	13	45	65	59	84	56	59	113	502
0.0 < Disp. ≤ 0.1	6	8	13	55	53	59	74	79	73	105	525
0.1 < Disp. ≤ 0.2	8	6	22	47	50	36	48	52	54	84	407
0.2 < Disp. ≤ 0.3	4	10	16	21	25	30	40	26	25	54	251
0.3 < Disp. ≤ 0.4	6	7	18	15	19	17	17	23	18	28	168
0.4 < Disp. ≤ 0.5	13	7	3	14	18	14	12	18	11	20	130
0.5 < Disp. ≤ 0.6	7	11	6	20	10	3	18	9	4	15	103
0.6 < Disp. ≤ 0.7	7	9	1	9	6	7	12	8	6	5	70
0.7 < Disp. ≤ 0.8	8	6	2	9	9	2	6	8	1	2	53
0.8 < Disp. ≤ 0.9	3	5	4	6	5	6	5	4	4	5	47
0.9 < Disp. ≤ 1.0	2	6	2	7	3	1	1	0	4	3	29
1.0 < Disp.	32	13	2	20	11	7	14	9	4	6	118
TOTAL	108	107	129	427	440	388	496	472	471	711	3749

Figure 18–6 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored concurrent calibration of operational data for the reading item bank. A line of best fit is included in the upper plot. The lower plot displays the same data as the upper, but color codes items by grade/course in an attempt to lend insight into the possible causes for the deviations.

Figure 18–6. Reading Banked Item Parameters vs. Anchored Calibration — All Items





Based on Figure 18–6, one can see that there are a number of items with operational estimates that differ from their banked values. Some of these are in kindergarten through grade 2. Recall that the operational CDT is available to students in grade 3 and above. While items were developed to sample content in kindergarten through grade 2 to provide better diagnostic information for lower performing students, the data from the operational administration did not include students below grade 3. To investigate whether this had an impact on the stability of the item parameter estimates, a concurrent anchored calibration of all items in grade 3 and above was run.

Figure 18–7 and Table 18–5 summarize the displacements from a concurrent anchored calibration of all items in grade 3 and above. Eighty-four percent of the items in the calibration have displacement less than 0.5 in magnitude (gray shaded in Table 18–5). Figure 18–8 shows banked item difficulties plotted against the item difficulties plus displacement. Again, a line of best fit is included in the upper plot.

Figure 18–7. Reading Anchored Calibration Displacements — All Items in Grade 3 and Above

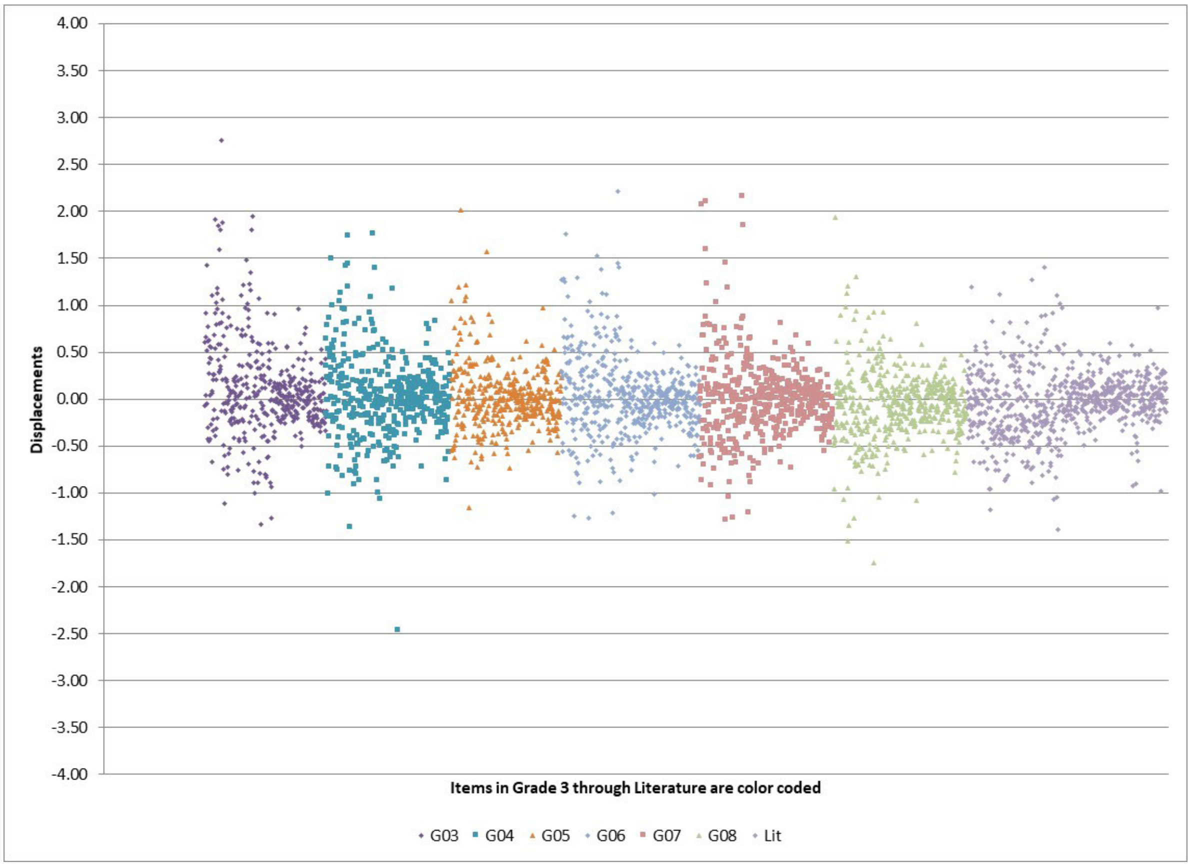
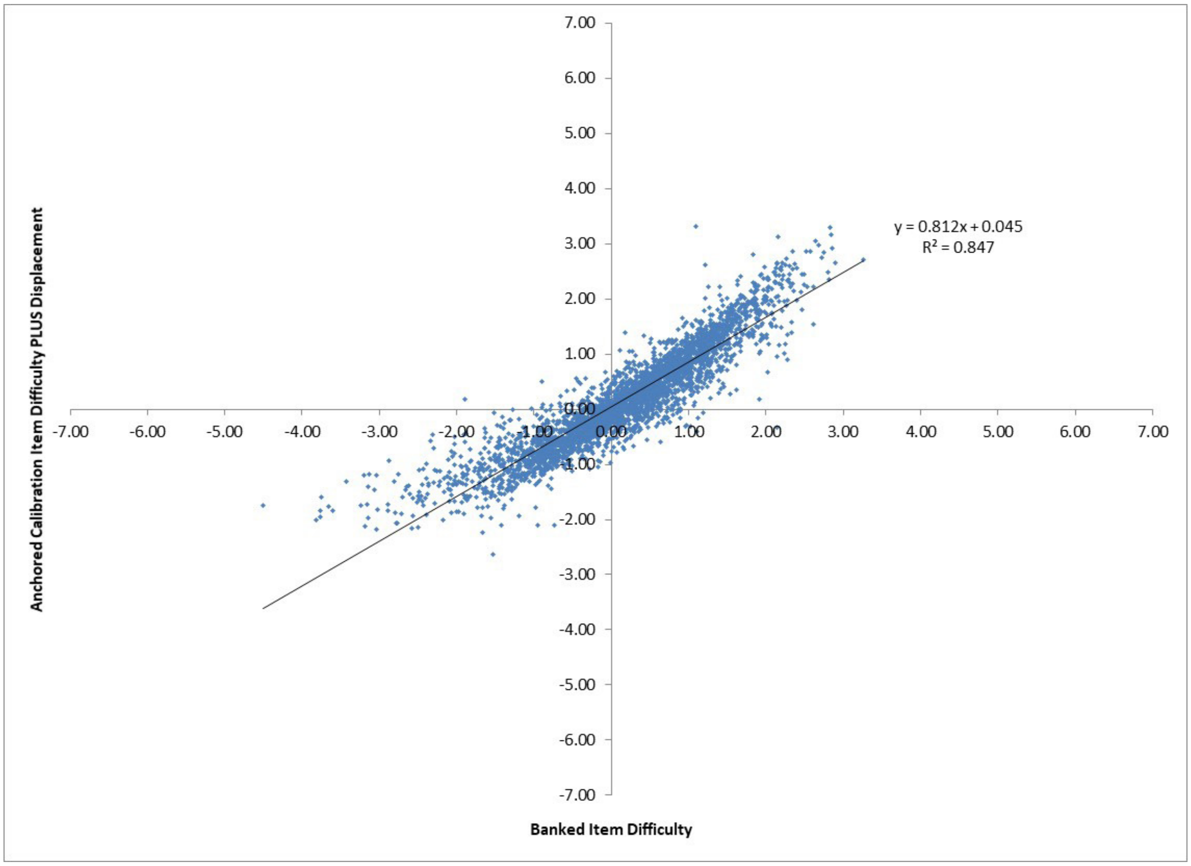
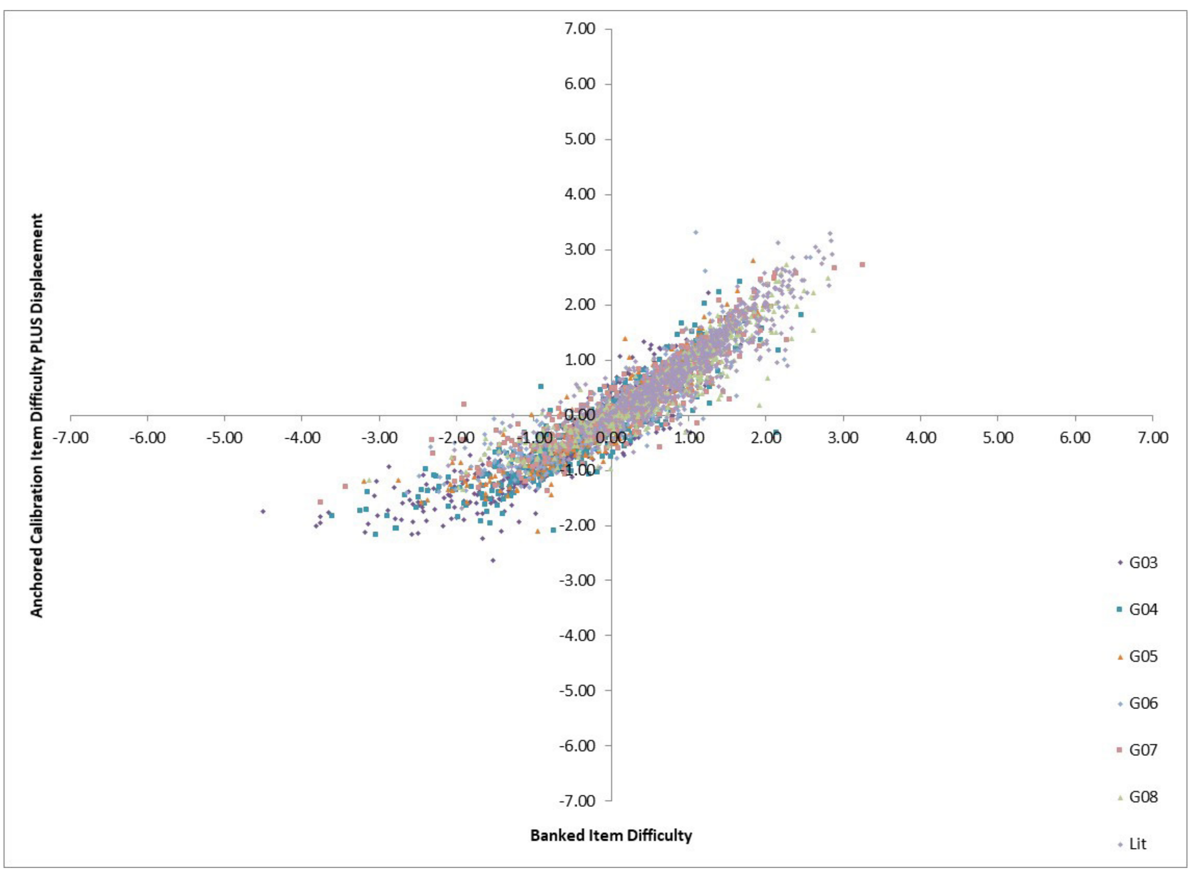


Table 18–5. Number of Reading Items by Grade/Course and Displacement Interval

Interval	G03	G04	G05	G06	G07	G08	LIT	Total
Disp. ≤ -1.0	4	5	1	4	4	7	4	29
-1.0 < Disp. ≤ -0.9	1	1	0	0	1	2	5	10
-0.9 < Disp. ≤ -0.8	6	5	0	4	4	0	6	25
-0.8 < Disp. ≤ -0.7	6	8	2	5	4	8	10	43
-0.7 < Disp. ≤ -0.6	6	10	3	9	10	9	14	61
-0.6 < Disp. ≤ -0.5	4	11	10	11	15	19	12	82
-0.5 < Disp. ≤ -0.4	16	17	13	16	21	17	38	138
-0.4 < Disp. ≤ -0.3	12	23	22	24	24	39	38	182
-0.3 < Disp. ≤ -0.2	42	31	25	43	46	53	68	308
-0.2 < Disp. ≤ -0.1	48	45	63	47	51	54	76	384
-0.1 < Disp. ≤ 0.0	48	61	63	85	56	59	113	485
0.0 < Disp. ≤ 0.1	51	57	60	75	78	73	105	499
0.1 < Disp. ≤ 0.2	50	55	38	48	53	54	83	381
0.2 < Disp. ≤ 0.3	28	29	29	39	26	25	55	231
0.3 < Disp. ≤ 0.4	18	16	18	16	23	18	28	137
0.4 < Disp. ≤ 0.5	13	20	15	14	18	11	20	111
0.5 < Disp. ≤ 0.6	17	11	3	16	9	4	15	75
0.6 < Disp. ≤ 0.7	13	5	6	13	8	6	5	56
0.7 < Disp. ≤ 0.8	9	9	3	7	8	1	2	39
0.8 < Disp. ≤ 0.9	4	6	5	4	4	4	5	32
0.9 < Disp. ≤ 1.0	9	4	2	2	0	4	3	24
1.0 < Disp.	22	11	7	14	9	4	6	73
TOTAL	427	440	388	496	472	471	711	3405

Figure 18–8. Reading Banked Item Parameters vs. Anchored Calibration — All Items in Grade 3 and Above





It is evident from this series of plots that the item parameter estimates are reasonably stable for the items in grade 3 and above.

For both of the anchored calibrations described in this section, banked item parameters were compared to the banked item parameters plus the displacements by calculating a robust Z statistic for each item pairing. Table 18–6 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in each of the calibrations.

Table 18–6. Summary of Robust Z across Anchored Calibrations in Reading

Grade/ Course	Cal 1: Number of Items	Cal 1: Number of Items with ABS(Z) > 1.645	Cal 1: Percent of Items with ABS(Z) > 1.645	Cal 2: Number of Items	Cal 2: Number of Items with ABS(Z) > 1.645	Cal 2: Percent of Items with ABS(Z) > 1.645
Kindergarten	108	61	56%	0	0	N/A
Grade 1	107	53	50%	0	0	N/A
Grade 2	129	19	15%	0	0	N/A
Grade 3	427	101	24%	427	106	25%
Grade 4	440	88	20%	440	98	22%
Grade 5	388	43	11%	388	44	11%
Grade 6	496	91	18%	496	97	20%
Grade 7	472	77	16%	472	88	19%
Grade 8	471	70	15%	471	78	17%
Literature	711	91	13%	711	105	15%
Total	3749	694	19%	3405	616	18%
	Correlation = 0.930			Correlation = 0.920		
	Additive Constant = 0.039			Additive Constant = 0.009		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, in calibration 1, all items with absolute displacement greater than 0.502 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.491 to 0.502, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.491 have absolute value of robust Z greater than 1.645.

SCIENCE

Figure 18–9 shows the displacements from a concurrent anchored calibration of all science items using the operational data set. Items are color-coded by grade/course.

Figure 18–9. Science Anchored Calibration Displacements — All Items

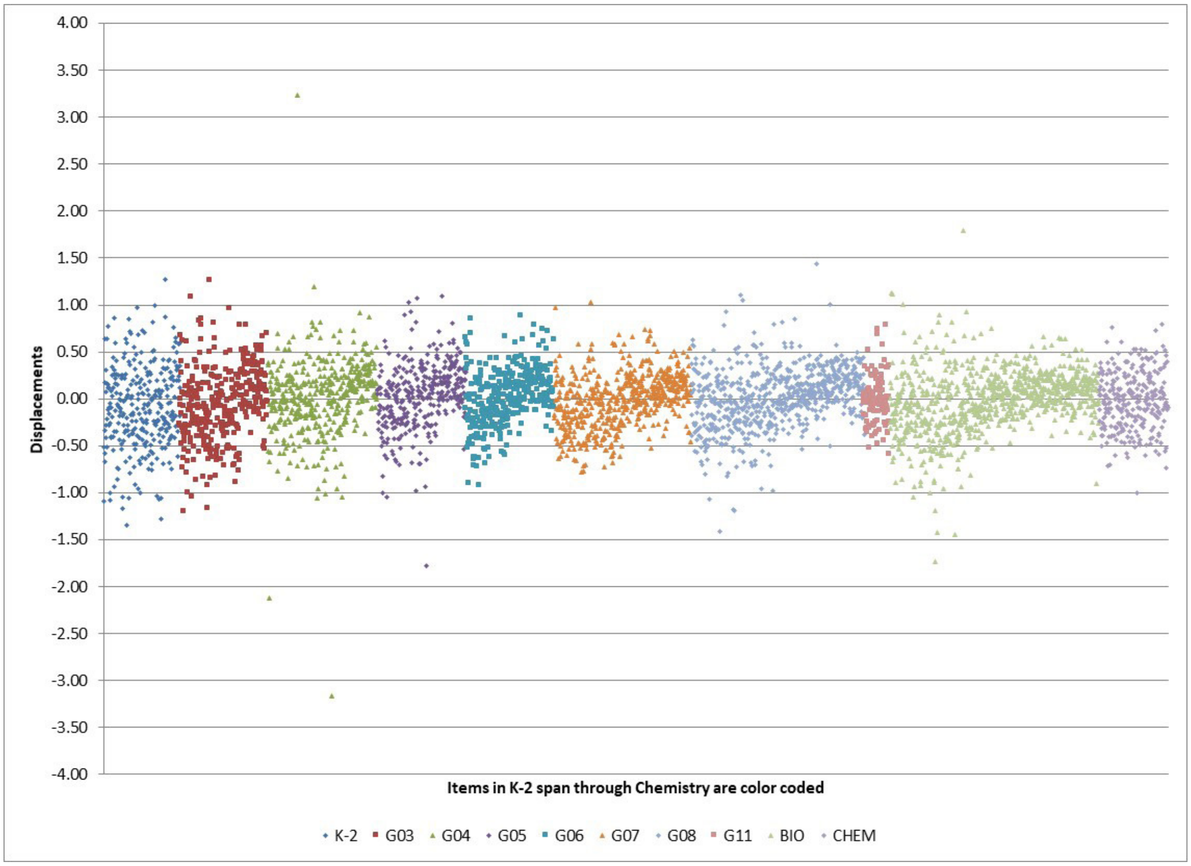


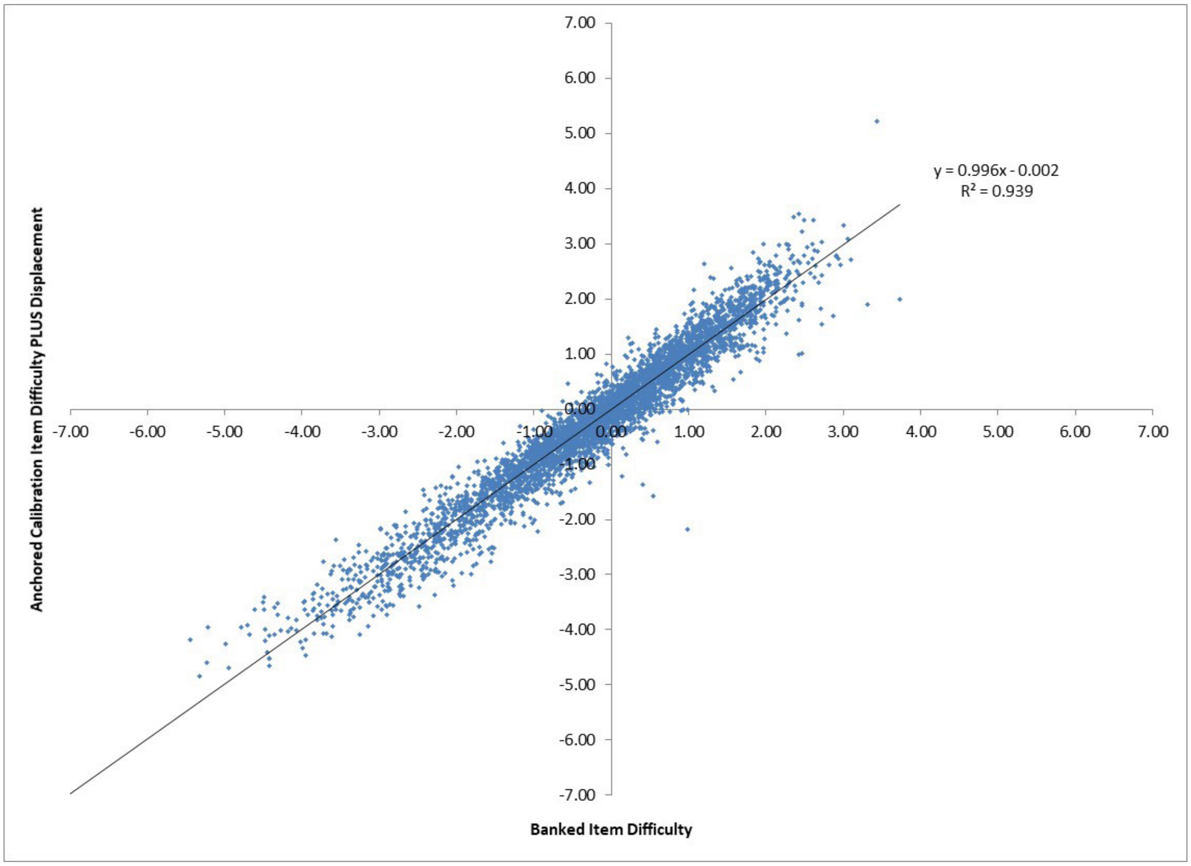
Table 18–7 summarizes the data in Figure 18–9. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-eight percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–7).

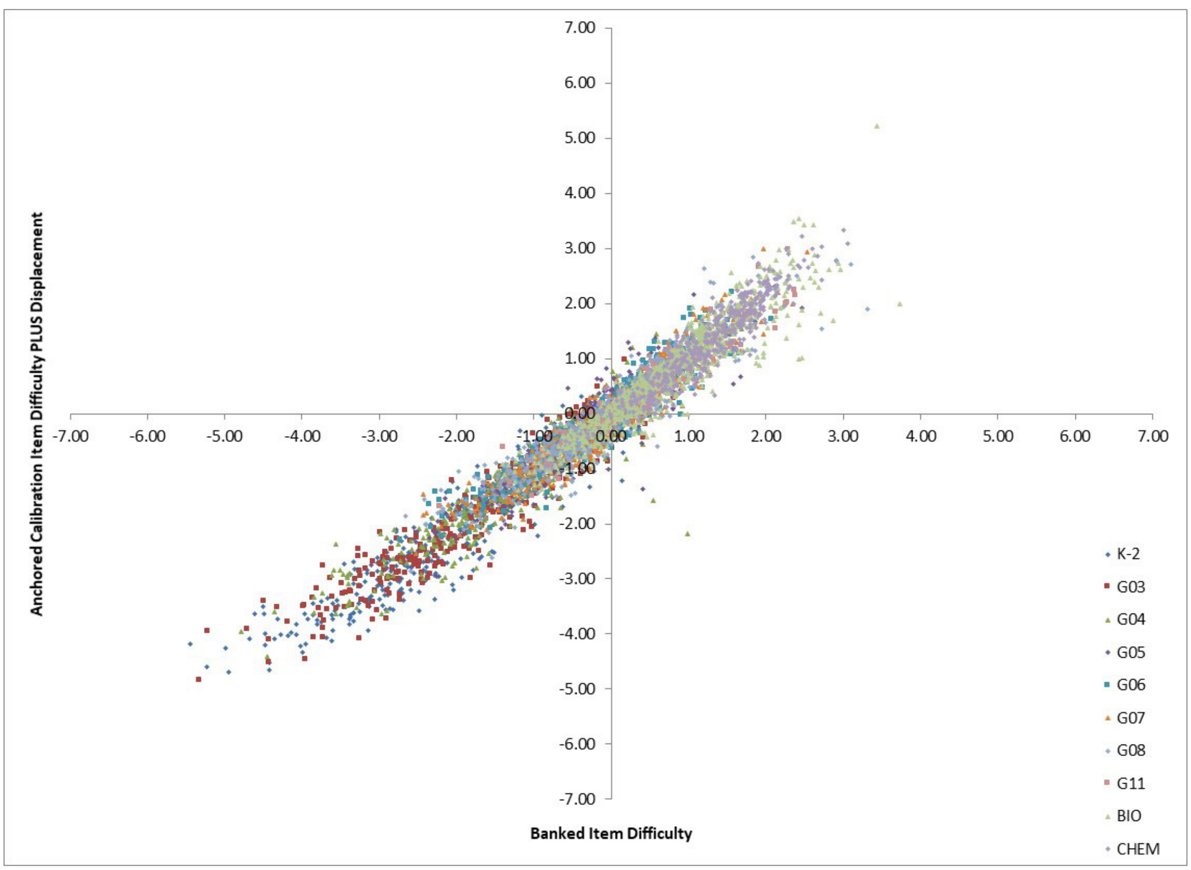
Table 18–7. Number of Science Items by Grade/Course and Displacement Interval

Interval	K–2	G03	G04	G05	G06	G07	G08	G11	BIO	CHEM	Total
Disp. ≤ -1.0	12	3	5	3	0	0	4	0	6	1	34
-1.0 < Disp. ≤ -0.9	3	2	2	2	2	0	2	0	4	0	17
-0.9 < Disp. ≤ -0.8	1	5	3	1	0	0	2	0	7	0	19
-0.8 < Disp. ≤ -0.7	7	6	7	1	2	5	6	0	5	2	41
-0.7 < Disp. ≤ -0.6	13	11	5	8	7	9	6	0	10	4	73
-0.6 < Disp. ≤ -0.5	11	20	10	6	7	12	13	2	23	7	111
-0.5 < Disp. ≤ -0.4	21	13	13	12	11	31	25	2	31	21	180
-0.4 < Disp. ≤ -0.3	26	19	23	15	19	35	39	10	42	23	251
-0.3 < Disp. ≤ -0.2	29	37	28	28	23	47	48	11	65	32	348
-0.2 < Disp. ≤ -0.1	25	28	41	31	38	50	63	12	84	47	419
-0.1 < Disp. ≤ 0.0	22	41	52	30	49	71	94	20	105	49	533
0.0 < Disp. ≤ 0.1	29	40	46	54	43	87	94	18	126	77	614
0.1 < Disp. ≤ 0.2	24	33	67	47	48	73	100	6	125	40	563
0.2 < Disp. ≤ 0.3	21	30	42	36	42	57	70	8	83	43	432
0.3 < Disp. ≤ 0.4	17	22	34	33	23	23	52	7	42	39	292
0.4 < Disp. ≤ 0.5	13	9	21	18	11	16	28	1	23	19	159
0.5 < Disp. ≤ 0.6	8	8	7	9	5	12	15	2	9	11	86
0.6 < Disp. ≤ 0.7	7	7	9	2	6	5	1	1	11	4	53
0.7 < Disp. ≤ 0.8	5	3	4	2	4	2	3	2	3	3	31
0.8 < Disp. ≤ 0.9	4	3	3	3	2	0	2	0	3	1	21
0.9 < Disp. ≤ 1.0	2	1	1	1	0	1	1	0	1	0	8
1.0 < Disp.	1	2	2	3	0	1	4	0	4	0	17
TOTAL	301	343	425	345	342	537	672	102	812	423	4302

Figure 18–10 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored concurrent calibration of operational data for the science item bank. A line of best fit is included in the upper plot. If item difficulties from the operational calibration are close to the banked values, the line will approach an intercept of zero and a slope of one. The lower plot displays the same data as the upper, but color codes items by grade/course in an attempt to lend insight into the possible causes for the deviations.

Figure 18–10. Science Banked Item Parameters vs. Anchored Calibration — All Items





Based on Figure 18–10, one can see that there are a number of items with operational estimates that differ from their banked values. Some of these are in the K–2 span. Recall that the operational CDT is available to students in grade 3 and above. While items were developed to sample content in the K–2 span to provide better diagnostic information for lower performing students, the data from the operational administration did not include students below grade 3. To investigate whether this had an impact on the stability of the item parameter estimates, a concurrent anchored calibration of all items in grade 3 and above was run.

Figure 18–11 and Table 18–8 summarize the displacements from a concurrent anchored calibration of all items in grade 3 and above. Eighty-nine percent of the items in the calibration have displacement less than 0.5 in magnitude (gray shaded in Table 18–8). Figure 18–12 shows banked item difficulties plotted against the item difficulties plus displacement. Again, a line of best fit is included in the upper plot.

Figure 18–11. Science Anchored Calibration Displacements — All Items in Grade 3 and Above

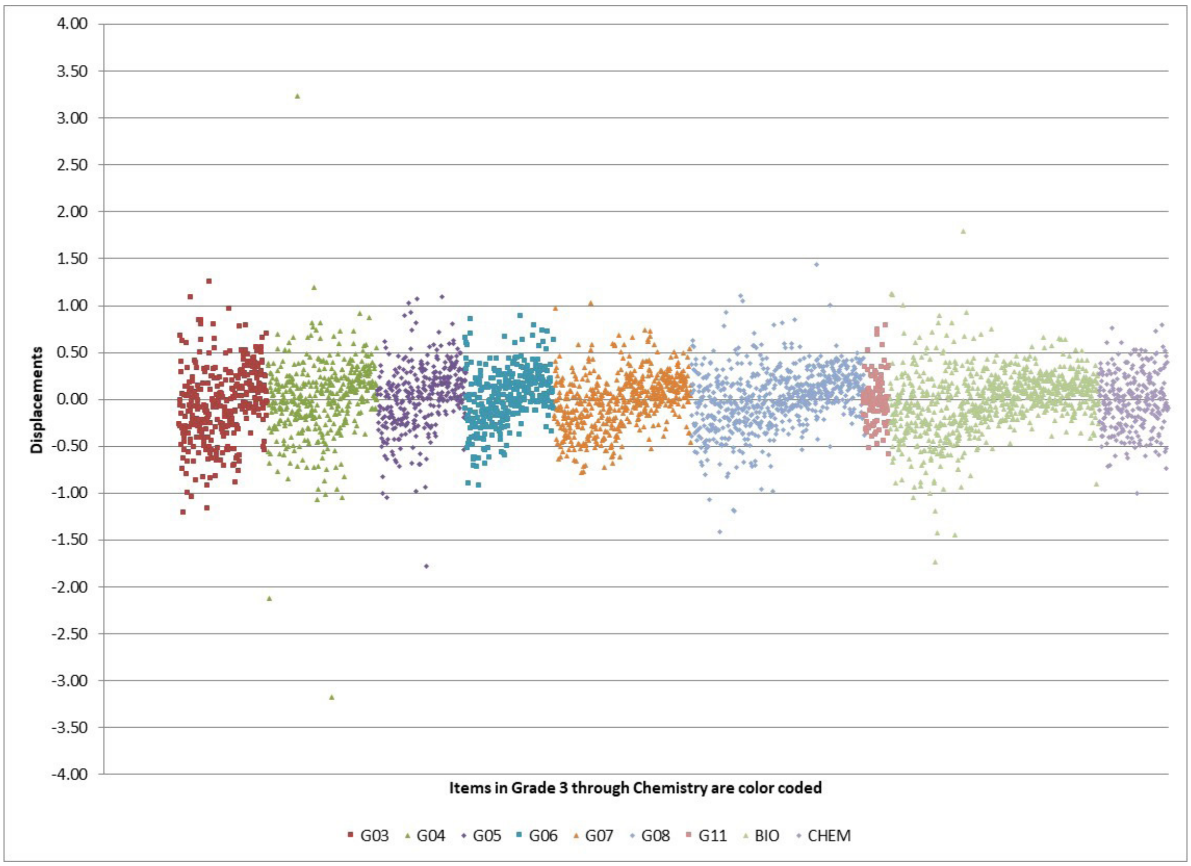
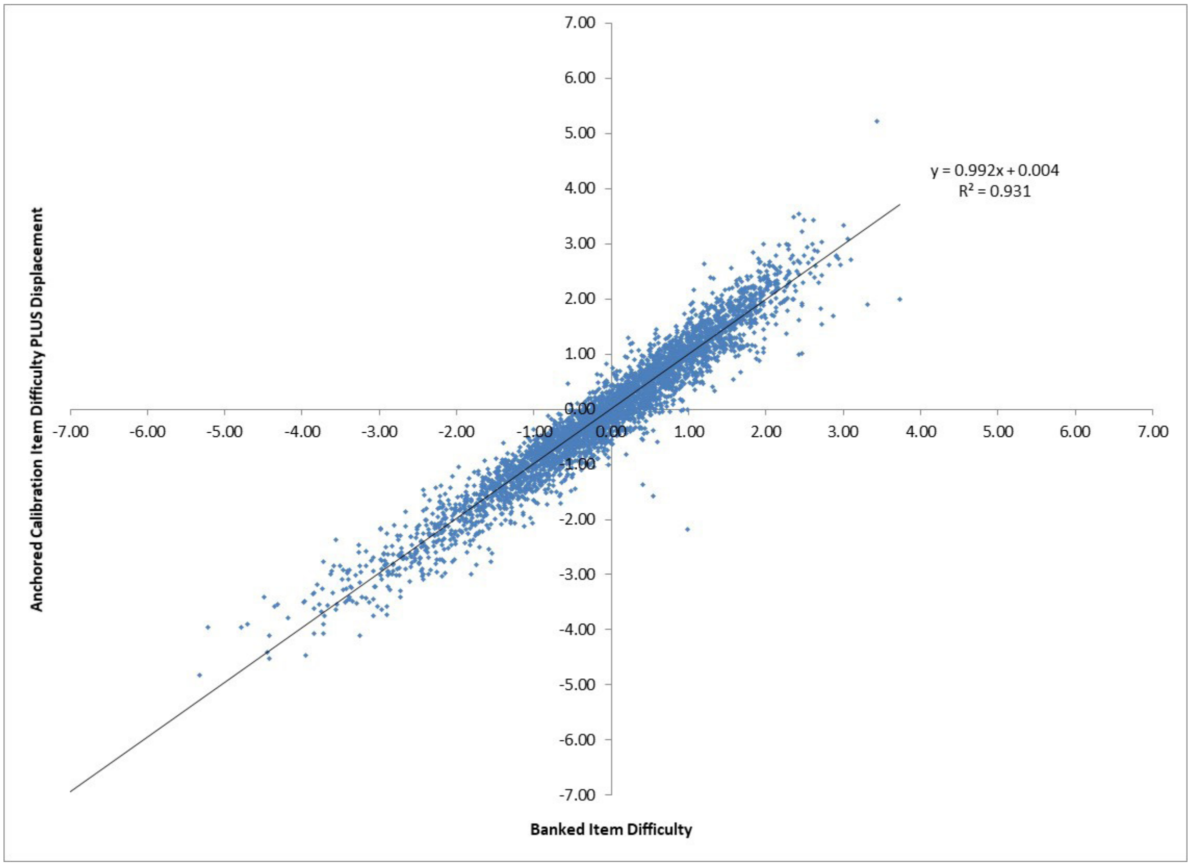
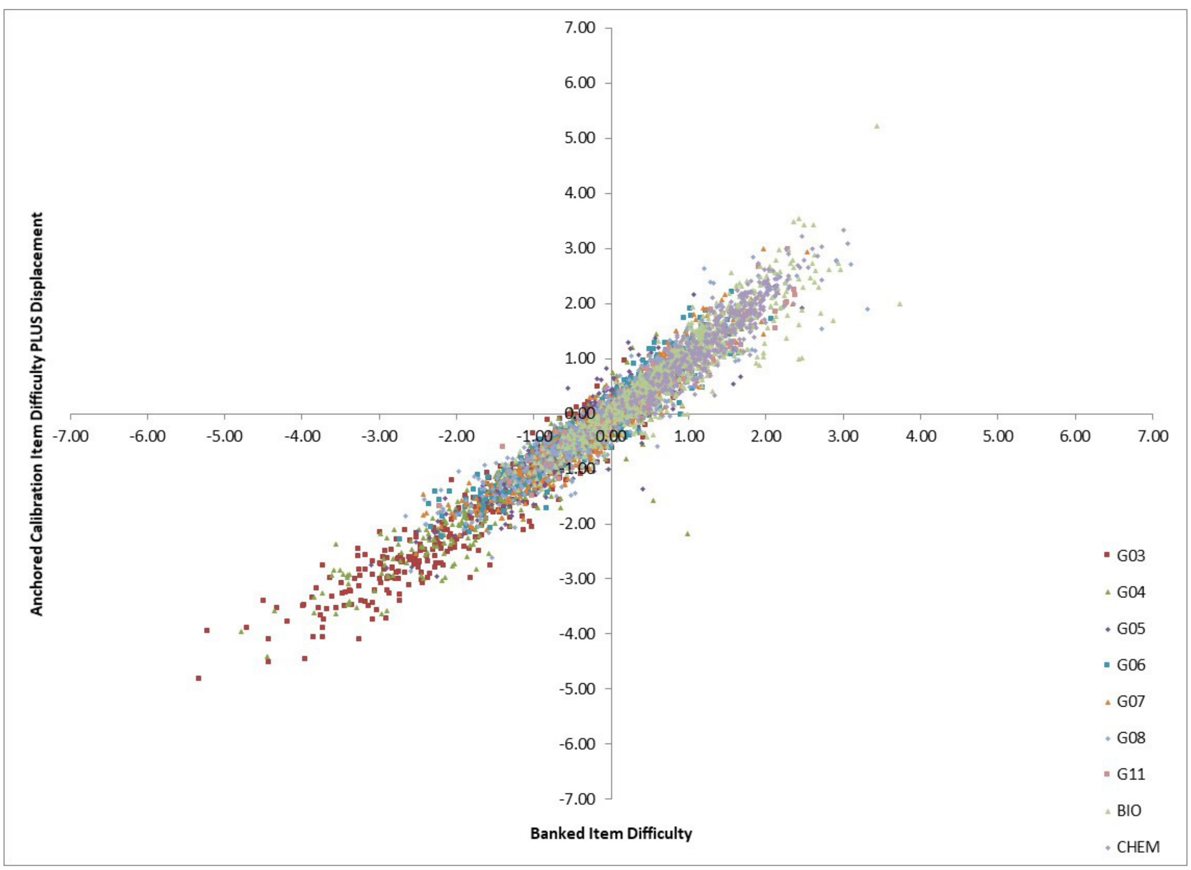


Table 18–8. Number of Science Items by Grade/Course and Displacement Interval

Interval	G03	G04	G05	G06	G07	G08	G11	BIO	CHEM	Total
Disp. ≤ -1.0	3	5	3	0	0	4	0	6	1	22
-1.0 < Disp. ≤ -0.9	2	2	2	2	0	2	0	4	0	14
-0.9 < Disp. ≤ -0.8	5	3	1	0	0	2	0	7	0	18
-0.8 < Disp. ≤ -0.7	6	7	1	2	5	6	0	5	2	34
-0.7 < Disp. ≤ -0.6	11	5	8	7	9	6	0	10	4	60
-0.6 < Disp. ≤ -0.5	21	10	6	7	12	13	2	23	7	101
-0.5 < Disp. ≤ -0.4	13	14	12	11	31	25	2	31	21	160
-0.4 < Disp. ≤ -0.3	20	24	15	19	35	39	10	42	23	227
-0.3 < Disp. ≤ -0.2	35	28	28	23	47	48	11	65	32	317
-0.2 < Disp. ≤ -0.1	28	40	30	38	50	63	12	84	47	392
-0.1 < Disp. ≤ 0.0	42	51	31	49	71	94	20	105	49	512
0.0 < Disp. ≤ 0.1	39	48	54	43	87	94	18	126	77	586
0.1 < Disp. ≤ 0.2	35	65	47	48	73	100	6	125	40	539
0.2 < Disp. ≤ 0.3	29	42	36	42	57	70	8	83	43	410
0.3 < Disp. ≤ 0.4	20	35	33	23	23	52	7	42	39	274
0.4 < Disp. ≤ 0.5	11	20	18	11	16	28	1	24	19	148
0.5 < Disp. ≤ 0.6	7	8	9	5	12	15	2	8	11	77
0.6 < Disp. ≤ 0.7	7	8	2	6	5	1	1	11	4	45
0.7 < Disp. ≤ 0.8	4	4	2	4	2	3	2	3	3	27
0.8 < Disp. ≤ 0.9	2	3	3	2	0	2	0	3	1	16
0.9 < Disp. ≤ 1.0	1	1	1	0	1	1	0	1	0	6
1.0 < Disp.	2	2	3	0	1	4	0	4	0	16
TOTAL	343	425	345	342	537	672	102	812	423	4001

Figure 18–12. Science Banked Item Parameters vs. Anchored Calibration — All Items in Grade 3 and Above





It is evident from this series of plots that the item parameter estimates are reasonably stable for the items in grade 3 and above.

For both of the anchored calibrations described in this section, banked item parameters were compared to the banked item parameters plus the displacements by calculating a robust Z statistic for each item pairing. If item difficulties from the operational calibration are close to the banked values, the correlation will be high and the additive constant near zero. Table 18–9 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in each of the calibrations.

Table 18–9. Summary of Robust Z across Anchored Calibrations in Science

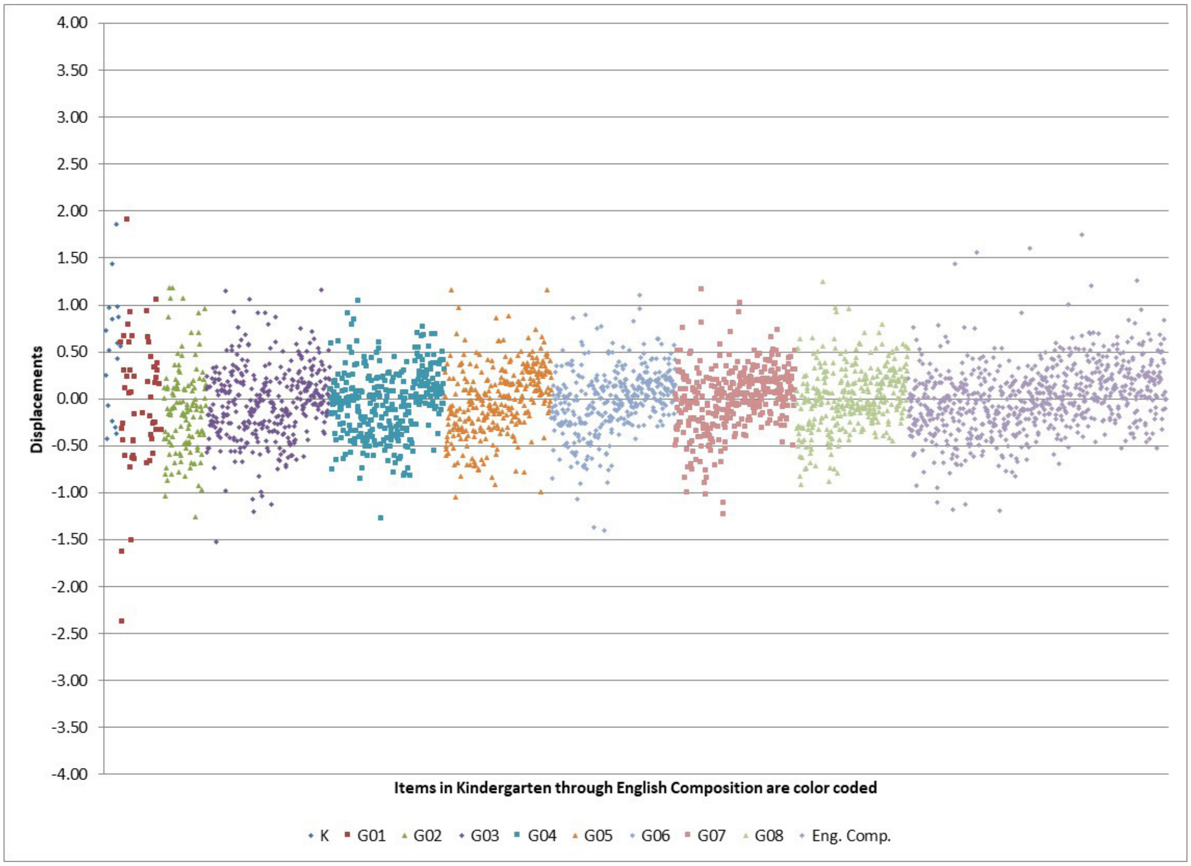
Grade/ Course	Cal 1: Number of Items	Cal 1: Number of Items with ABS(Z) > 1.645	Cal 1: Percent of Items with ABS(Z) > 1.645	Cal 2: Number of Items	Cal 2: Number of Items with ABS(Z) > 1.645	Cal 2: Percent of Items with ABS(Z) > 1.645
K–2 span	301	79	26%	0	0	N/A
Grade 3	343	71	21%	343	75	22%
Grade 4	425	61	14%	425	64	15%
Grade 5	345	42	12%	345	46	13%
Grade 6	342	37	11%	342	38	11%
Grade 7	537	53	10%	537	60	11%
Grade 8	672	67	10%	672	69	10%
Grade 11	102	8	8%	102	8	8%
Biology	812	95	12%	812	98	12%
Chemistry	423	39	9%	423	43	10%
Total	4302	552	13%	4001	501	13%
	Correlation = 0.969			Correlation = 0.965		
	Additive Constant = -0.002			Additive Constant = 0.004		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, in calibration 1, all items with absolute displacement greater than 0.509 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.470 to 0.509, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.470 have absolute value of robust Z greater than 1.645.

WRITING/ENGLISH COMPOSITION

Figure 18–13 shows the displacements from a concurrent anchored calibration of all writing items using the operational data set. Items are color-coded by grade/course.

Figure 18–13. Writing Anchored Calibration Displacements — All Items



Note: Many kindergarten items were not estimated by WINSTEPS software due to insufficient counts.

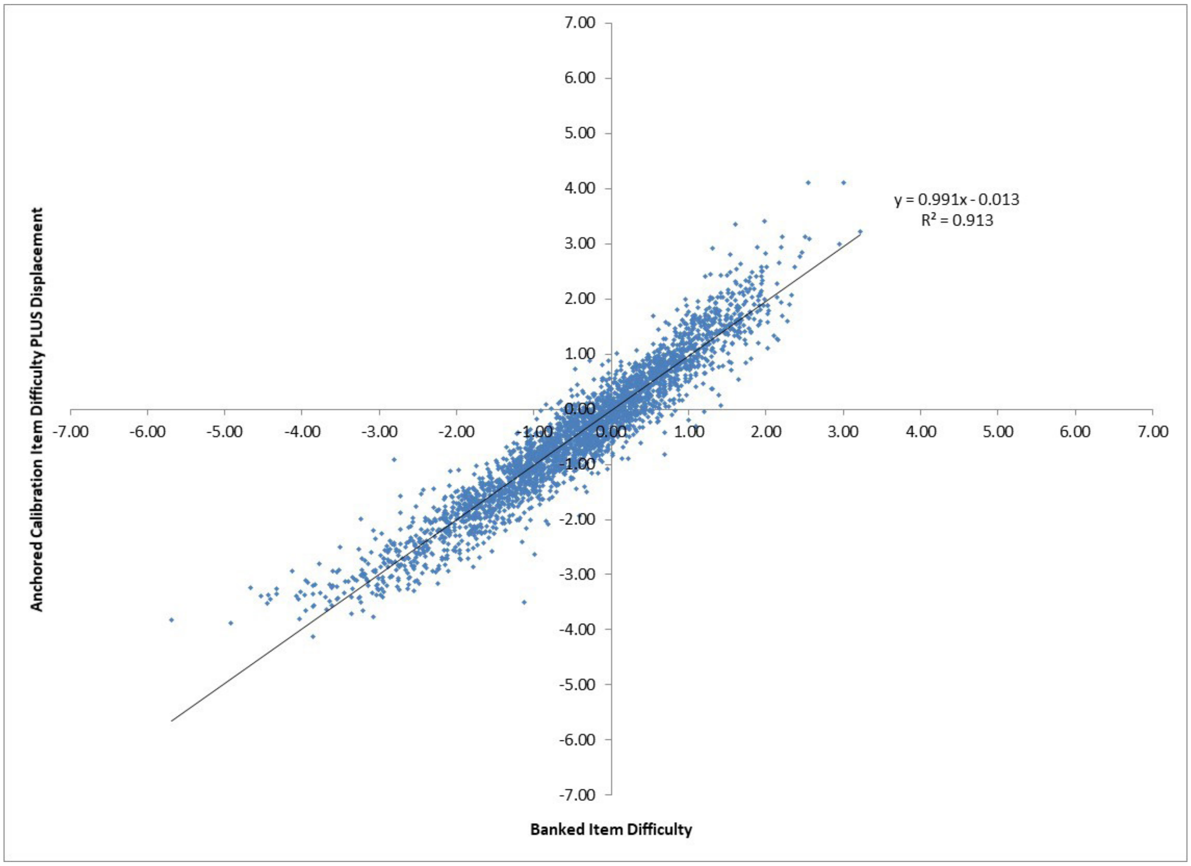
Table 18–10 summarizes the data in Figure 18–13. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-four percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–10).

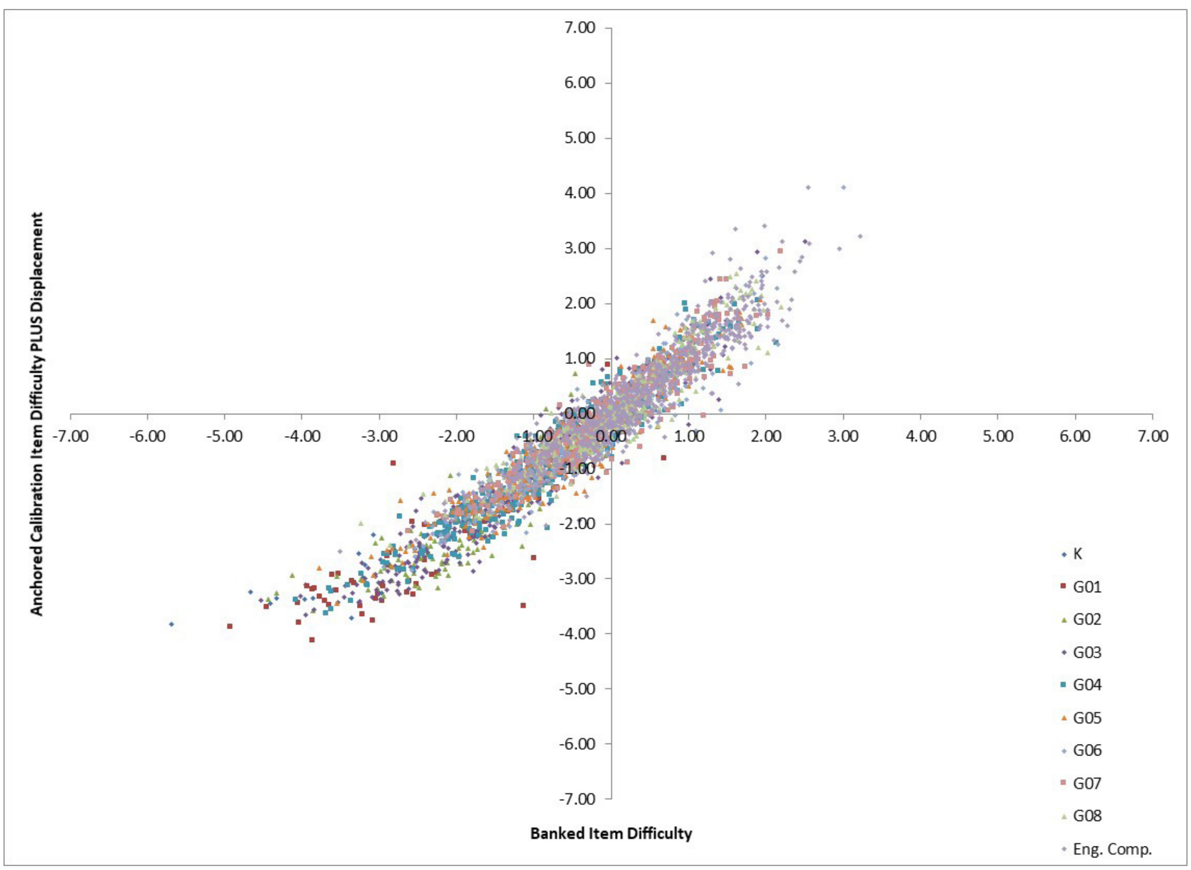
Table 18–10. Number of Writing Items by Grade/Course and Displacement Interval

Interval	K	G01	G02	G03	G04	G05	G06	G07	G08	COMP	Total
Disp. ≤ -1.0	0	3	2	5	1	1	3	3	0	4	22
-1.0 < Disp. ≤ -0.9	0	0	2	2	0	2	1	1	1	2	11
-0.9 < Disp. ≤ -0.8	0	0	2	1	5	2	2	3	2	1	18
-0.8 < Disp. ≤ -0.7	0	1	5	4	4	8	8	5	6	6	47
-0.7 < Disp. ≤ -0.6	0	6	7	9	11	7	6	3	3	14	66
-0.6 < Disp. ≤ -0.5	0	1	8	16	14	9	9	10	8	18	93
-0.5 < Disp. ≤ -0.4	1	4	9	21	24	12	13	14	13	35	146
-0.4 < Disp. ≤ -0.3	1	4	11	25	22	27	12	18	24	49	193
-0.3 < Disp. ≤ -0.2	2	5	3	32	27	22	38	34	24	67	254
-0.2 < Disp. ≤ -0.1	0	3	15	39	23	34	32	24	31	82	283
-0.1 < Disp. ≤ 0.0	1	0	13	38	43	29	47	47	53	78	349
0.0 < Disp. ≤ 0.1	0	3	6	39	51	38	51	50	37	88	363
0.1 < Disp. ≤ 0.2	0	4	16	40	27	32	53	44	33	81	330
0.2 < Disp. ≤ 0.3	1	6	6	29	28	27	34	39	31	72	273
0.3 < Disp. ≤ 0.4	0	3	4	20	18	25	17	25	24	43	179
0.4 < Disp. ≤ 0.5	1	1	3	11	14	16	16	14	10	34	120
0.5 < Disp. ≤ 0.6	3	2	2	14	7	4	9	7	15	26	89
0.6 < Disp. ≤ 0.7	0	4	0	4	7	8	3	1	3	15	45
0.7 < Disp. ≤ 0.8	1	1	2	4	2	1	2	3	3	6	25
0.8 < Disp. ≤ 0.9	2	0	1	1	1	2	3	1	0	3	14
0.9 < Disp. ≤ 1.0	2	2	2	3	1	1	1	1	3	2	18
1.0 < Disp.	2	2	4	3	1	2	1	2	1	7	25
TOTAL	17	55	123	360	331	309	361	349	325	733	2963

Figure 18–14 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored concurrent calibration of operational data for the writing item bank. A line of best fit is included in the upper plot. If item difficulties from the operational calibration are close to the banked values, the line will approach an intercept of zero and a slope of one. The lower plot displays the same data as the upper, but color codes items by grade/course in an attempt to lend insight into the possible causes for the deviations.

Figure 18–14. Writing Banked Item Parameters vs. Anchored Calibration — All Items





Based on Figure 18–14, one can see that there are a number of items with operational estimates that differ from their banked values. Some of these are in kindergarten through grade 2. Recall that the operational CDT is available to students in grade 3 and above. While items were developed to sample content in kindergarten through grade 2 to provide better diagnostic information for lower performing students, the data from the operational administration did not include students below grade 3. To investigate whether this had an impact on the stability of the item parameter estimates, a concurrent anchored calibration of all items in grade 3 and above was run.

Figure 18–15 and Table 18–11 summarize the displacements from a concurrent anchored calibration of all items in grade 3 and above. Eighty-five percent of the items in the calibration have displacement less than 0.5 in magnitude (gray shaded in Table 18–11). Figure 18–16 shows banked item difficulties plotted against the item difficulties plus displacement. Again, a line of best fit is included in the upper plot.

Figure 18–15. Writing Anchored Calibration Displacements — All Items in Grade 3 and Above

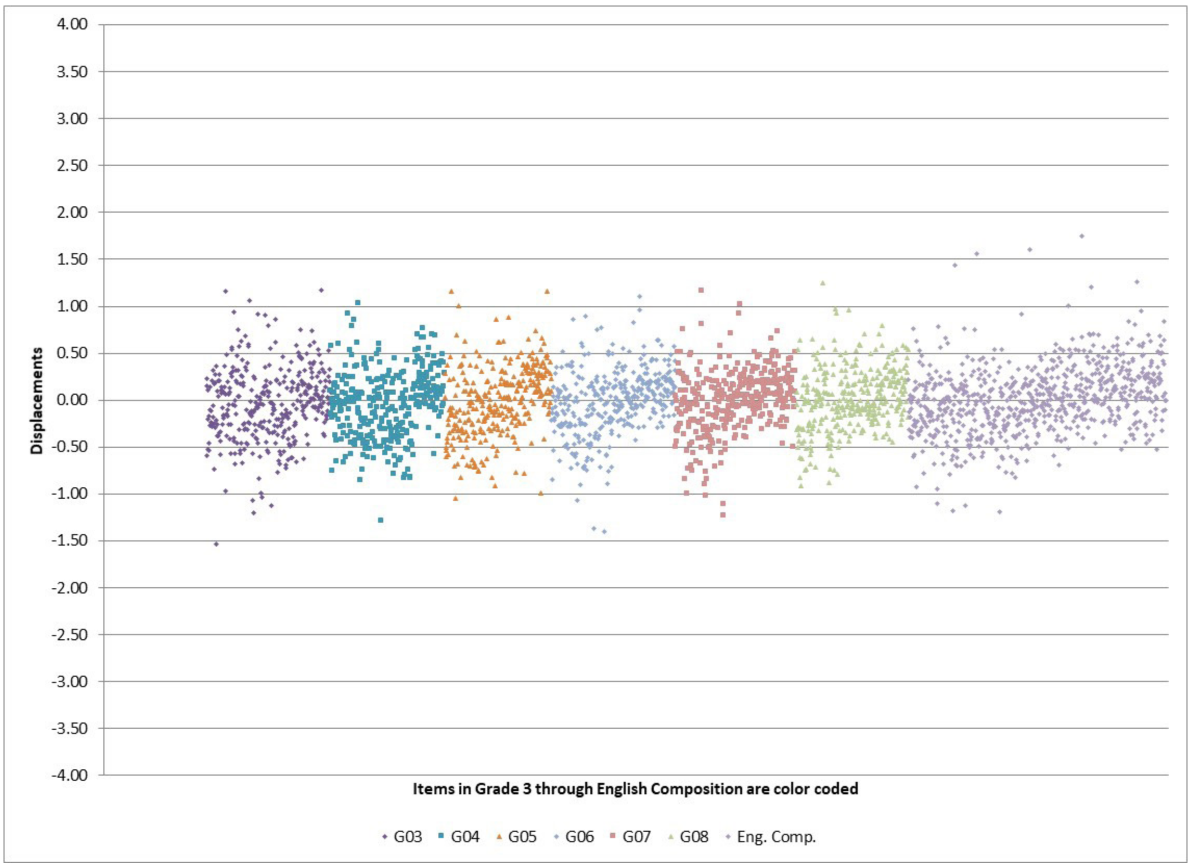
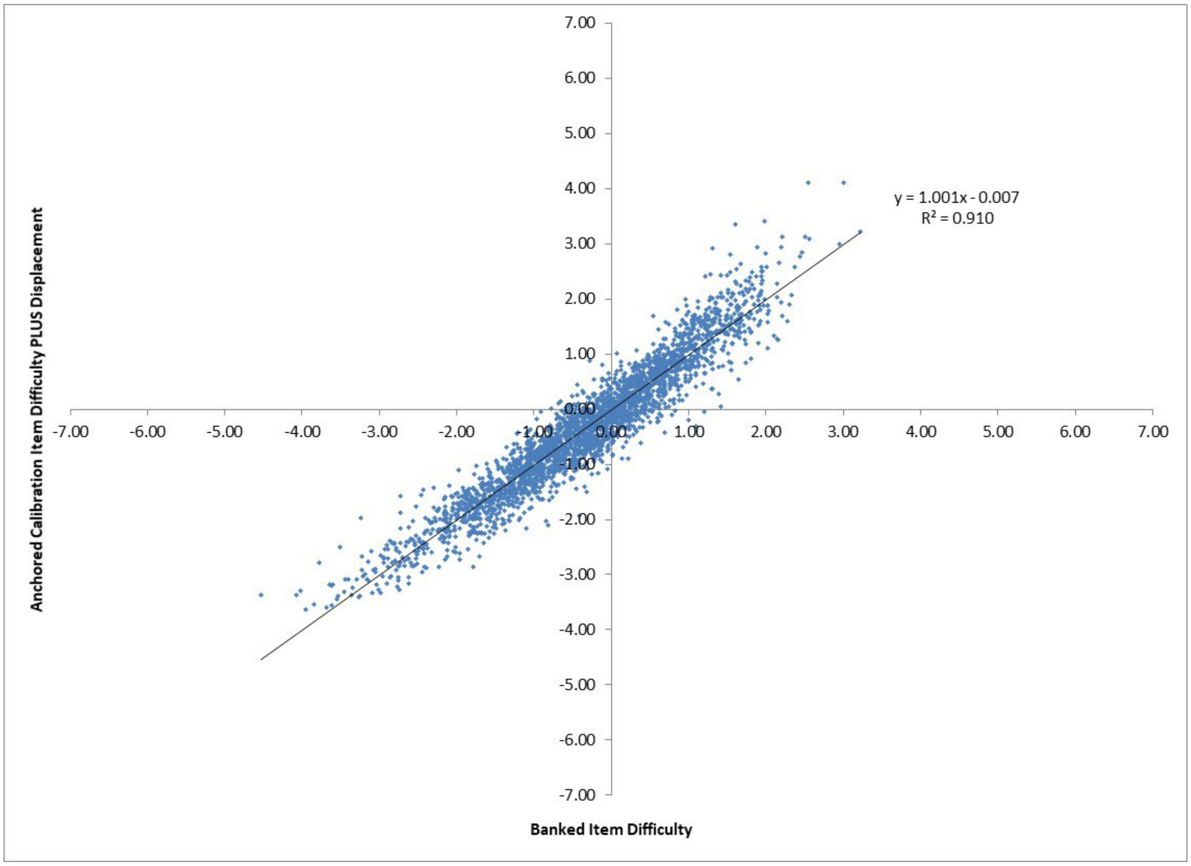
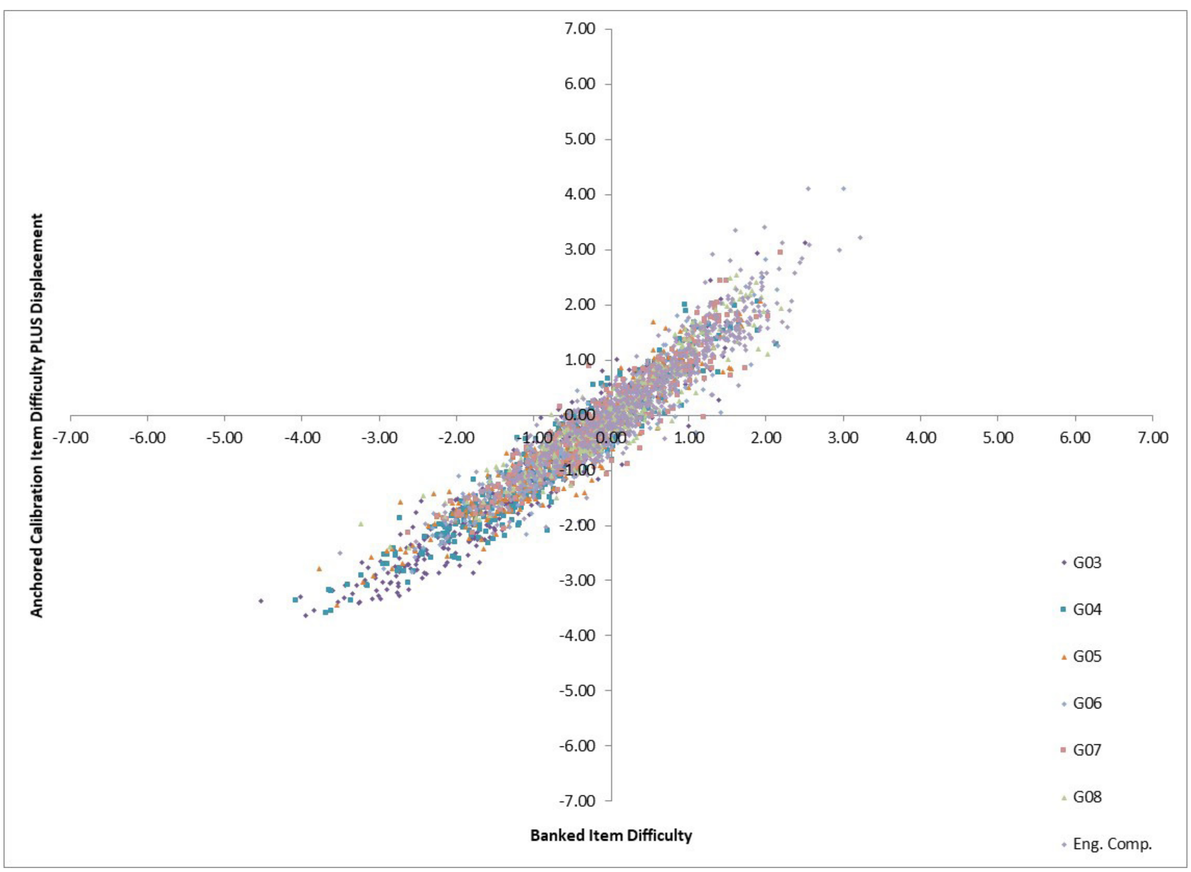


Table 18–11. Number of Writing Items by Grade/Course and Displacement Interval

Interval	G03	G04	G05	G06	G07	G08	COMP	Total
Disp. ≤ -1.0	5	1	1	3	3	0	4	17
-1.0 < Disp. ≤ -0.9	2	0	2	1	1	1	2	9
-0.9 < Disp. ≤ -0.8	1	5	2	2	3	2	1	16
-0.8 < Disp. ≤ -0.7	3	5	8	8	5	6	6	41
-0.7 < Disp. ≤ -0.6	11	10	7	6	3	3	14	54
-0.6 < Disp. ≤ -0.5	15	15	10	8	10	8	18	84
-0.5 < Disp. ≤ -0.4	21	23	12	14	14	13	35	132
-0.4 < Disp. ≤ -0.3	25	24	26	12	18	24	49	178
-0.3 < Disp. ≤ -0.2	35	25	22	38	34	24	67	245
-0.2 < Disp. ≤ -0.1	37	24	34	32	24	31	82	264
-0.1 < Disp. ≤ 0.0	39	42	29	47	47	53	78	335
0.0 < Disp. ≤ 0.1	38	52	37	50	50	37	88	352
0.1 < Disp. ≤ 0.2	42	26	33	54	44	33	81	313
0.2 < Disp. ≤ 0.3	27	28	25	34	39	31	72	256
0.3 < Disp. ≤ 0.4	21	18	27	17	25	24	43	175
0.4 < Disp. ≤ 0.5	12	14	16	16	14	10	34	116
0.5 < Disp. ≤ 0.6	11	8	4	9	7	15	26	80
0.6 < Disp. ≤ 0.7	4	6	8	3	1	3	15	40
0.7 < Disp. ≤ 0.8	4	2	1	2	3	3	6	21
0.8 < Disp. ≤ 0.9	1	1	2	3	1	0	3	11
0.9 < Disp. ≤ 1.0	3	1	0	1	1	3	2	11
1.0 < Disp.	3	1	3	1	2	1	7	18
TOTAL	360	331	309	361	349	325	733	2768

Figure 18–16. Writing Banked Item Parameters vs. Anchored Calibration — All Items in Grade 3 and Above





It is evident from this series of plots that the item parameter estimates are reasonably stable for the items in grade 3 and above.

For both of the anchored calibrations described in this section, banked item parameters were compared to the banked item parameters plus the displacements by calculating a robust Z statistic for each item pairing. If item difficulties from the operational calibration are close to the banked values, the correlation will be high and the additive constant near zero. Table 18–12 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in each of the calibrations.

Table 18–12. Summary of Robust Z across Anchored Calibrations in Writing

Grade/ Course	Cal 1: Number of Items	Cal 1: Number of Items with ABS(Z) > 1.645	Cal 1: Percent of Items with ABS(Z) > 1.645	Cal 2: Number of Items	Cal 2: Number of Items with ABS(Z) > 1.645	Cal 2: Percent of Items with ABS(Z) > 1.645
Kindergarten	17	9	53%	0	0	N/A
Grade 1	55	22	40%	0	0	N/A
Grade 2	123	34	28%	0	0	N/A
Grade 3	360	52	14%	360	57	16%
Grade 4	331	40	12%	331	42	13%
Grade 5	309	38	12%	309	39	13%
Grade 6	361	40	11%	361	43	12%
Grade 7	349	27	8%	349	28	8%
Grade 8	325	30	9%	325	31	10%
English Comp	733	78	11%	733	80	11%
Total	2963	370	12%	2768	320	12%
	Correlation = 0.955			Correlation = 0.954		
	Additive Constant = -0.009			Additive Constant = -0.007		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, in calibration 1, all items with absolute displacement greater than 0.557 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.553 to 0.557, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.553 have absolute value of robust Z greater than 1.645.

ANCHORED GRADE LEVEL CALIBRATIONS

While the CDT content area item banks are vertically scaled with items from Kindergarten through high school courses, the assessments themselves are first made available in grade 3. Also, while the items are selected adaptively, most students take a large number of items at grade level. Given these conditions, item parameters were also evaluated by running anchored grade level item calibrations—grade 3 items calibrated with grade 3 students, and so on. This is similar to how field-test items were calibrated. Table 18–13 shows the number of students in each grade level calibration.

Table 18–13. Number of Students in Grade Level Calibrations

Content Area	Grade/Course	Number of Students
Mathematics	Grade 3	47,075
Mathematics	Grade 4	47,829
Mathematics	Grade 5	56,519
Mathematics	Grade 6	66,543
Mathematics	Grade 7	75,149
Mathematics	Grade 8	64,771
Mathematics	Algebra I	99,483
Mathematics	Geometry	9,442
Mathematics	Algebra II	9,735
Reading	Grade 3	38,348
Reading	Grade 4	41,036
Reading	Grade 5	48,005
Reading	Grade 6	52,617
Reading	Grade 7	53,843
Reading	Grade 8	52,308
Reading	Reading/Literature	127,996
Science	Grade 3	3,396
Science	Grade 4	25,703
Science	Grade 5	9,795
Science	Grade 6	27,036
Science	Grade 7	51,273
Science	Grade 8	64,555
Science	High School	3,761
Science	Biology	115,867
Science	Chemistry	7,337
Writing	Grade 3	6,554
Writing	Grade 4	7,538
Writing	Grade 5	9,469
Writing	Grade 6	13,002
Writing	Grade 7	17,300
Writing	Grade 8	17,188
Writing	Writing/English Composition	8,295

MATHEMATICS

Figure 18–17 shows the displacements from the anchored grade level calibrations of operational data for the mathematics item bank. Items are color-coded by grade/course.

Figure 18–17. Mathematics Anchored Grade Level Calibrations Displacements — All Items in Grade 3 and Above

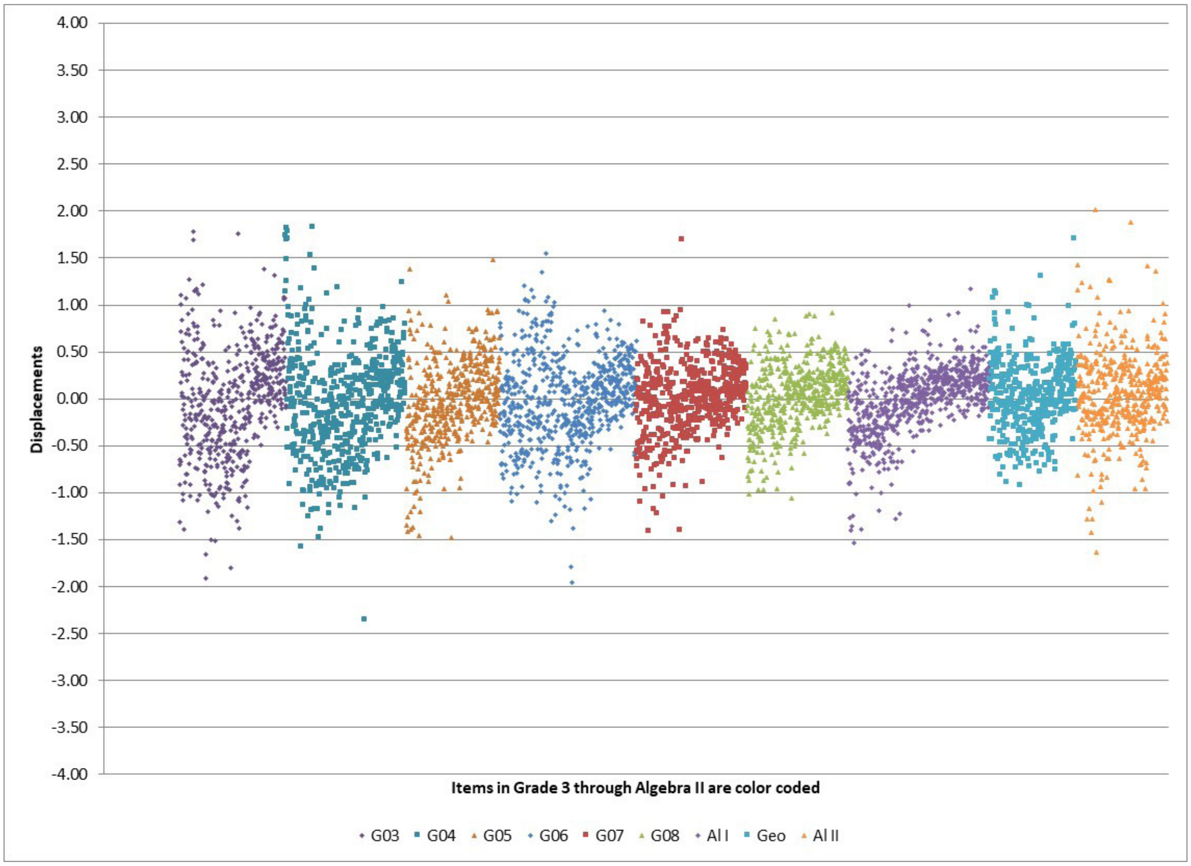


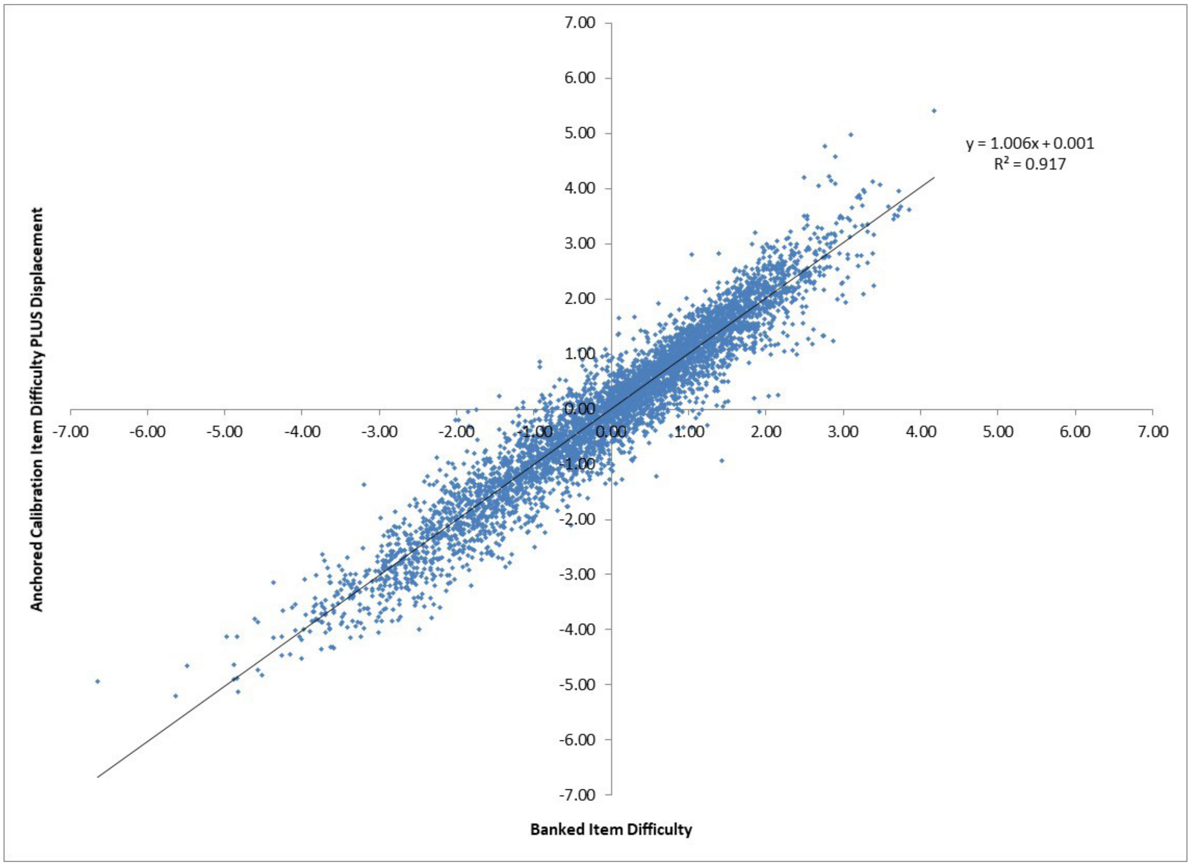
Table 18–14 summarizes the data in Figure 18–17. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Seventy-eight percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–14).

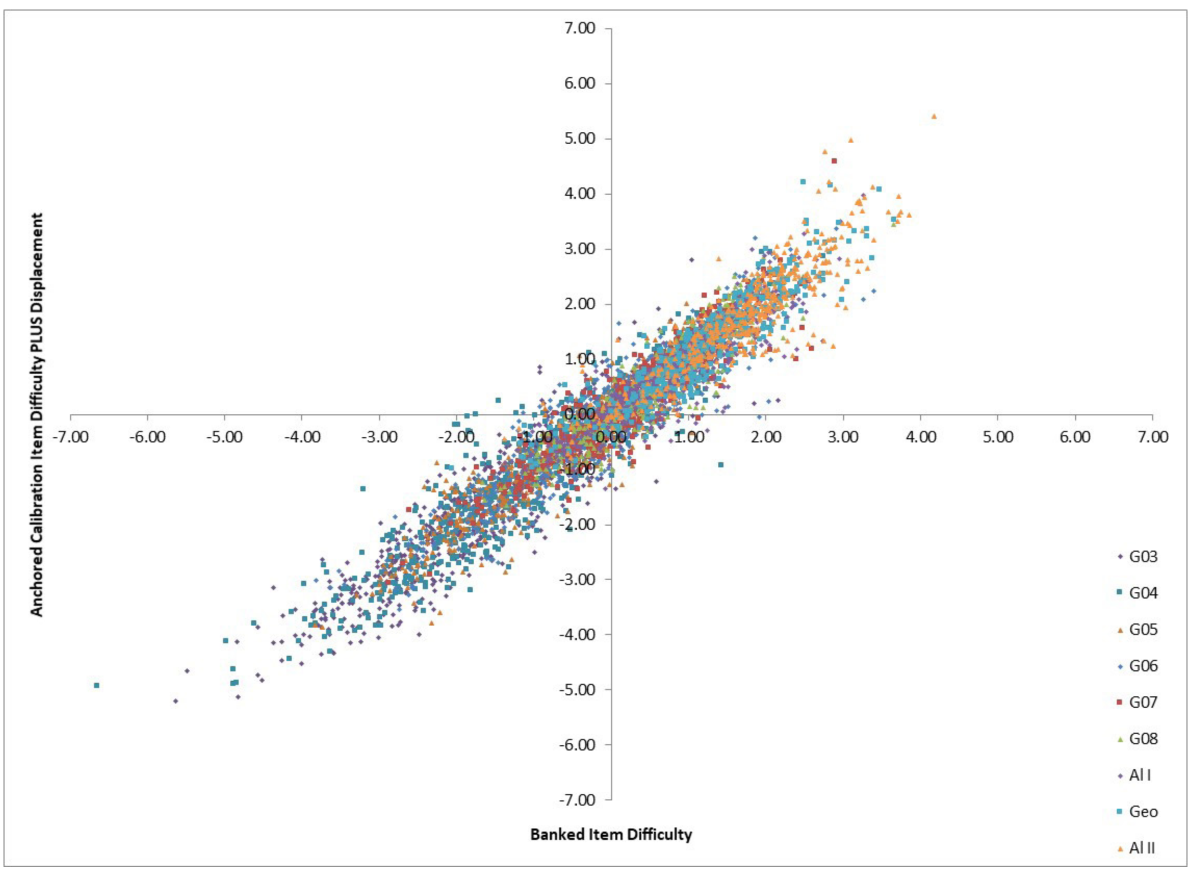
Table 18–14. Number of Mathematics Items by Grade/Course and Displacement Interval

Interval	G03	G04	G05	G06	G07	G08	ALI	GEO	ALII	Total
Disp. ≤ -1.0	29	17	12	14	6	2	10	0	6	96
-1.0 < Disp. ≤ -0.9	12	15	4	10	4	3	5	1	4	58
-0.9 < Disp. ≤ -0.8	8	11	6	8	3	4	1	2	6	49
-0.8 < Disp. ≤ -0.7	19	20	4	15	5	5	8	6	2	84
-0.7 < Disp. ≤ -0.6	17	24	9	24	18	5	15	15	10	137
-0.6 < Disp. ≤ -0.5	25	27	12	31	17	14	17	13	8	164
-0.5 < Disp. ≤ -0.4	23	29	28	17	26	20	26	22	10	201
-0.4 < Disp. ≤ -0.3	25	41	31	45	27	29	43	22	20	283
-0.3 < Disp. ≤ -0.2	30	34	33	57	41	28	37	26	40	326
-0.2 < Disp. ≤ -0.1	33	39	51	52	58	40	56	42	50	421
-0.1 < Disp. ≤ 0.0	34	59	46	63	57	58	83	57	35	492
0.0 < Disp. ≤ 0.1	41	36	53	50	70	67	84	40	54	495
0.1 < Disp. ≤ 0.2	40	49	31	80	60	57	104	44	42	507
0.2 < Disp. ≤ 0.3	31	44	33	46	41	63	99	37	46	440
0.3 < Disp. ≤ 0.4	34	35	26	43	39	29	46	37	36	325
0.4 < Disp. ≤ 0.5	28	23	35	35	27	29	29	28	21	255
0.5 < Disp. ≤ 0.6	23	22	12	25	17	22	12	13	14	160
0.6 < Disp. ≤ 0.7	17	13	13	18	12	9	3	4	12	101
0.7 < Disp. ≤ 0.8	19	13	10	12	6	3	7	4	6	80
0.8 < Disp. ≤ 0.9	7	15	1	11	3	3	2	2	3	47
0.9 < Disp. ≤ 1.0	6	6	7	6	3	2	2	5	4	41
1.0 < Disp.	17	17	4	11	1	0	1	5	12	68
TOTAL	518	589	461	673	541	492	690	425	441	4830

Figure 18–18 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored grade level calibrations of all items using the operational data set. Again, a line of best fit is included in the upper plot.

Figure 18–18. Mathematics Banked Item Parameters vs. Anchored Grade Level Calibrations — All Items in Grade 3 and Above





For the anchored grade level calibrations described above, banked item parameters were compared to the newly calibrated values by calculating a robust Z statistic for each item pairing. If item difficulties from the operational calibration are close to the banked values, the correlation will be high and the additive constant near zero. Table 18–15 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in the calibrations.

Table 18–15. Summary of Robust Z across Anchored Grade Level Calibrations in Mathematics

Grade/ Course	Cal 1: Number of Items	Cal 1: Number of Items with ABS(Z) > 1.645	Cal 1: Percent of Items with ABS(Z) > 1.645
Kindergarten	0	0	N/A
Grade 1	0	0	N/A
Grade 2	0	0	N/A
Grade 3	518	137	26%
Grade 4	589	138	23%
Grade 5	461	57	12%
Grade 6	673	117	17%
Grade 7	541	48	9%
Grade 8	492	32	7%
Algebra I	690	50	7%
Geometry	425	34	8%
Algebra II	441	57	13%
Total	4830	670	14%
	Correlation = 0.958		
	Additive Constant = 0.001		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, all items with absolute displacement greater than 0.659 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.619 to 0.659, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.619 have absolute value of robust Z greater than 1.645.

READING/LITERATURE

Figure 18–19 shows the displacements from the anchored grade level calibrations of operational data for the reading item bank. Items are color-coded by grade/course.

Figure 18–19. Reading Anchored Grade Level Calibrations Displacements — All Items in Grade 3 and Above

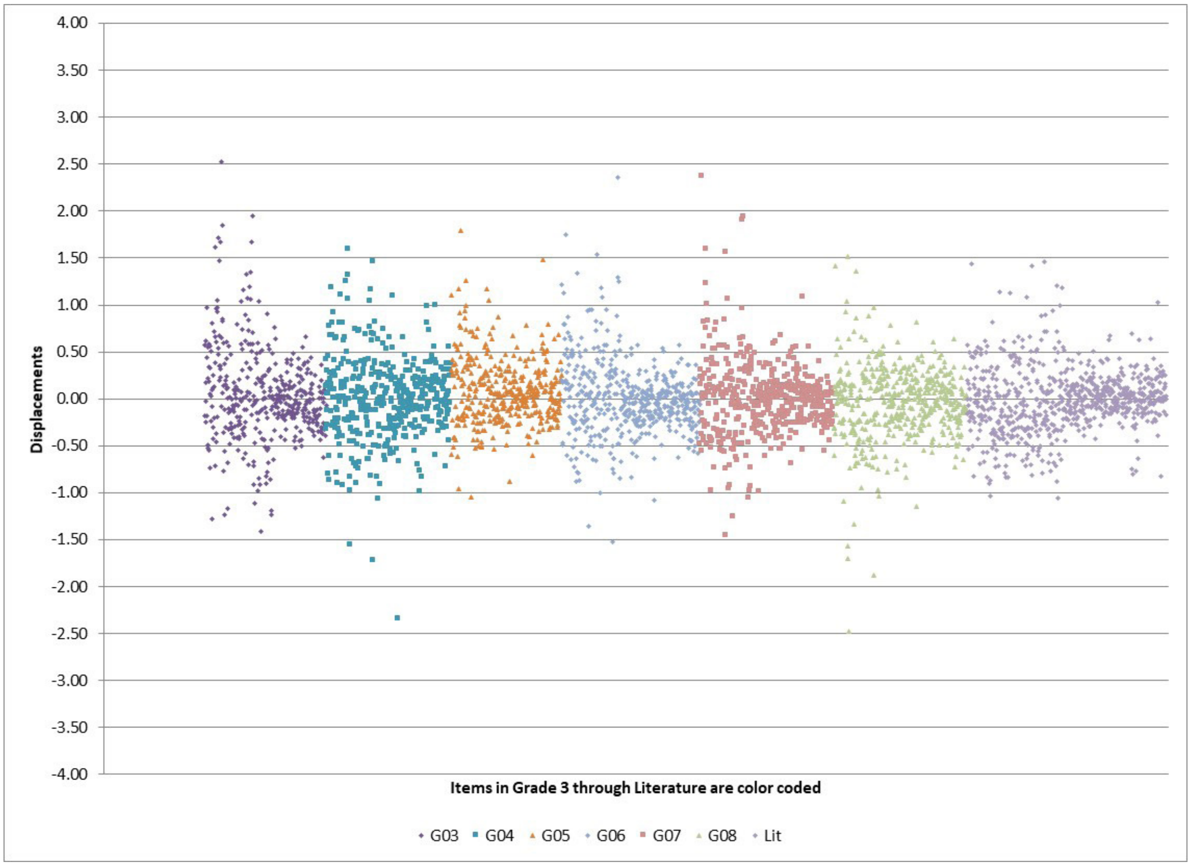


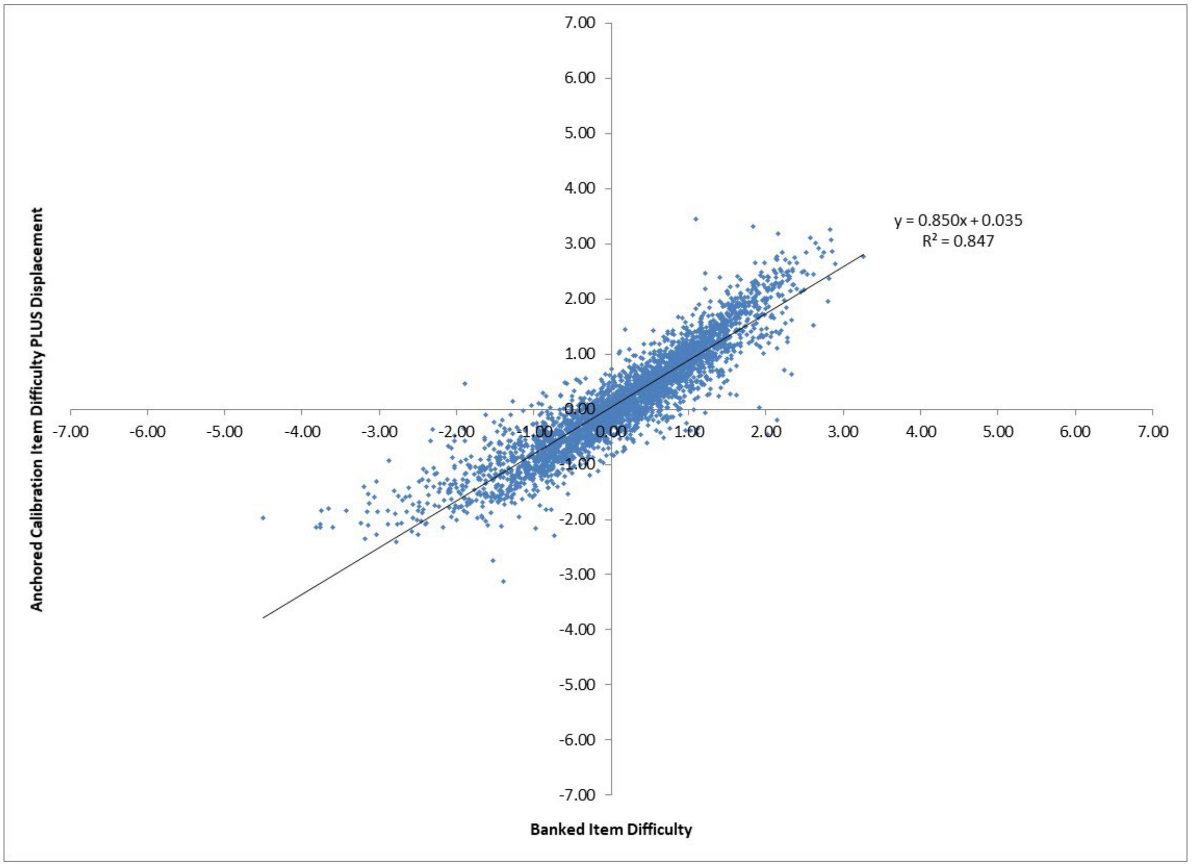
Table 18–16 summarizes the data in Figure 18–19. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-four percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–16).

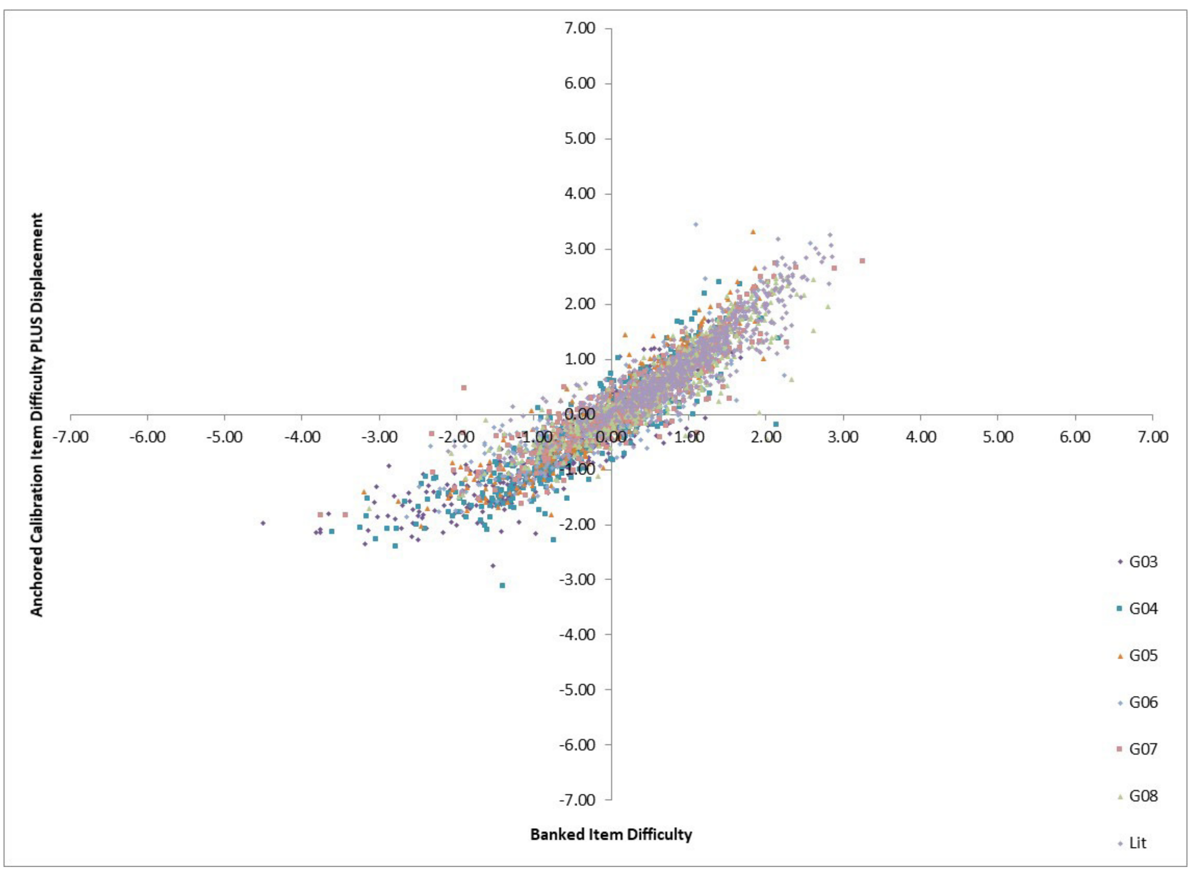
Table 18–16. Number of Reading Items by Grade/Course and Displacement Interval

Interval	G03	G04	G05	G06	G07	G08	LIT	Total
Disp. ≤ -1.0	7	4	1	4	3	8	2	29
-1.0 < Disp. ≤ -0.9	4	5	1	0	6	2	1	19
-0.9 < Disp. ≤ -0.8	3	6	1	4	0	1	9	24
-0.8 < Disp. ≤ -0.7	6	7	0	5	4	9	11	42
-0.7 < Disp. ≤ -0.6	6	11	1	12	5	13	12	60
-0.6 < Disp. ≤ -0.5	10	10	7	12	12	7	16	74
-0.5 < Disp. ≤ -0.4	19	17	12	19	27	24	20	138
-0.4 < Disp. ≤ -0.3	32	29	14	25	28	31	46	205
-0.3 < Disp. ≤ -0.2	27	40	37	51	46	48	57	306
-0.2 < Disp. ≤ -0.1	59	36	46	55	49	42	89	376
-0.1 < Disp. ≤ 0.0	45	51	53	66	56	61	112	444
0.0 < Disp. ≤ 0.1	53	53	49	85	77	62	112	491
0.1 < Disp. ≤ 0.2	38	48	47	43	59	56	73	364
0.2 < Disp. ≤ 0.3	20	35	34	35	23	42	51	240
0.3 < Disp. ≤ 0.4	24	31	21	17	26	29	31	179
0.4 < Disp. ≤ 0.5	12	13	19	16	15	13	24	112
0.5 < Disp. ≤ 0.6	20	5	15	18	15	5	15	93
0.6 < Disp. ≤ 0.7	9	13	8	6	5	7	13	61
0.7 < Disp. ≤ 0.8	6	7	9	5	2	2	3	34
0.8 < Disp. ≤ 0.9	5	5	2	4	4	3	3	26
0.9 < Disp. ≤ 1.0	5	3	3	4	1	2	2	20
1.0 < Disp.	17	10	7	10	9	4	9	66
TOTAL	427	439	387	496	472	471	711	3403

Figure 18–20 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored grade level calibrations of all items using the operational data set. Again, a line of best fit is included in the upper plot.

Figure 18–20. Reading Banked Item Parameters vs. Anchored Grade Level Calibrations — All Items in Grade 3 and Above





An examination of the items with larger differences between banked values and operational estimates revealed that a number of these have low *n*-counts in the operational calibration. To investigate whether this had an impact on the stability of the item parameter estimates, anchored grade level calibrations of all items in grade 3 and above with larger *n*-counts were run. Figure 18–21 shows the displacements from these calibrations. Items are color-coded by grade/course.

Figure 18–21. Reading Anchored Grade Level Calibrations Displacements — All Items in Grade 3 and Above with *N*>100

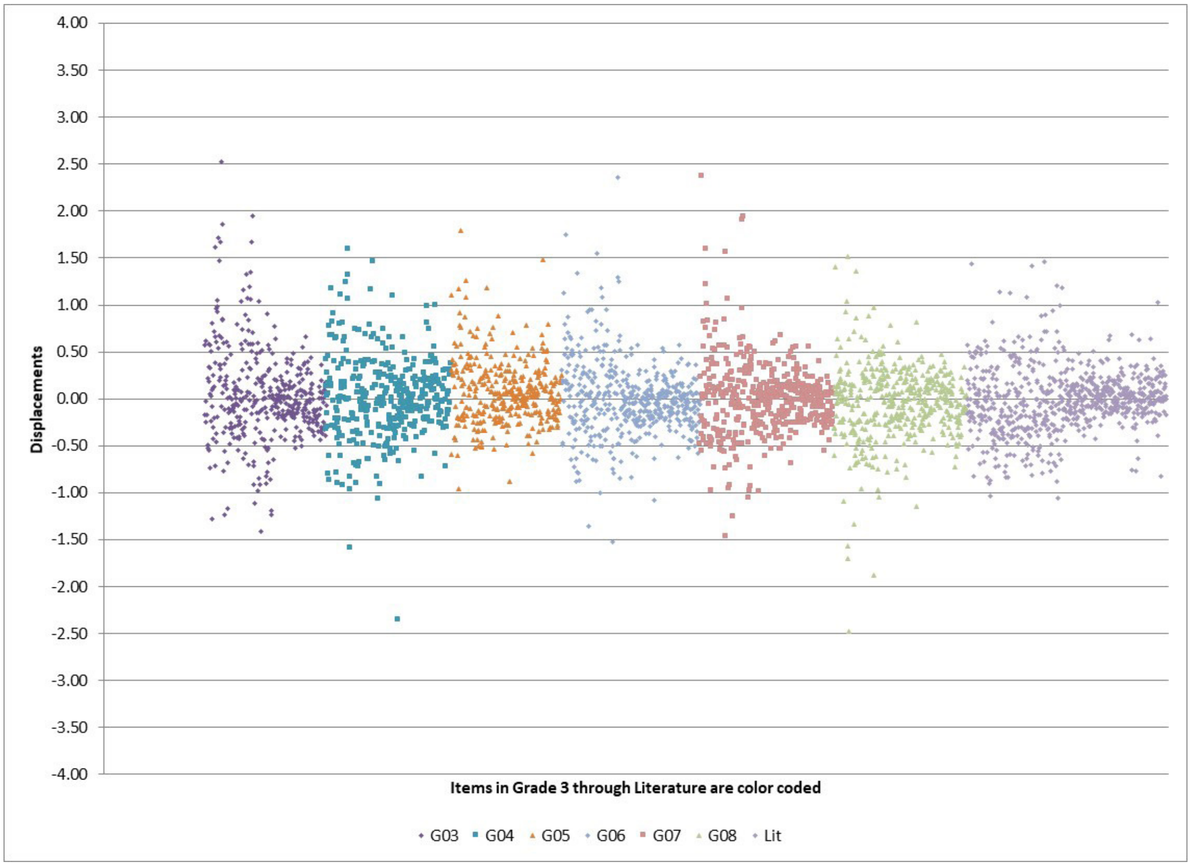


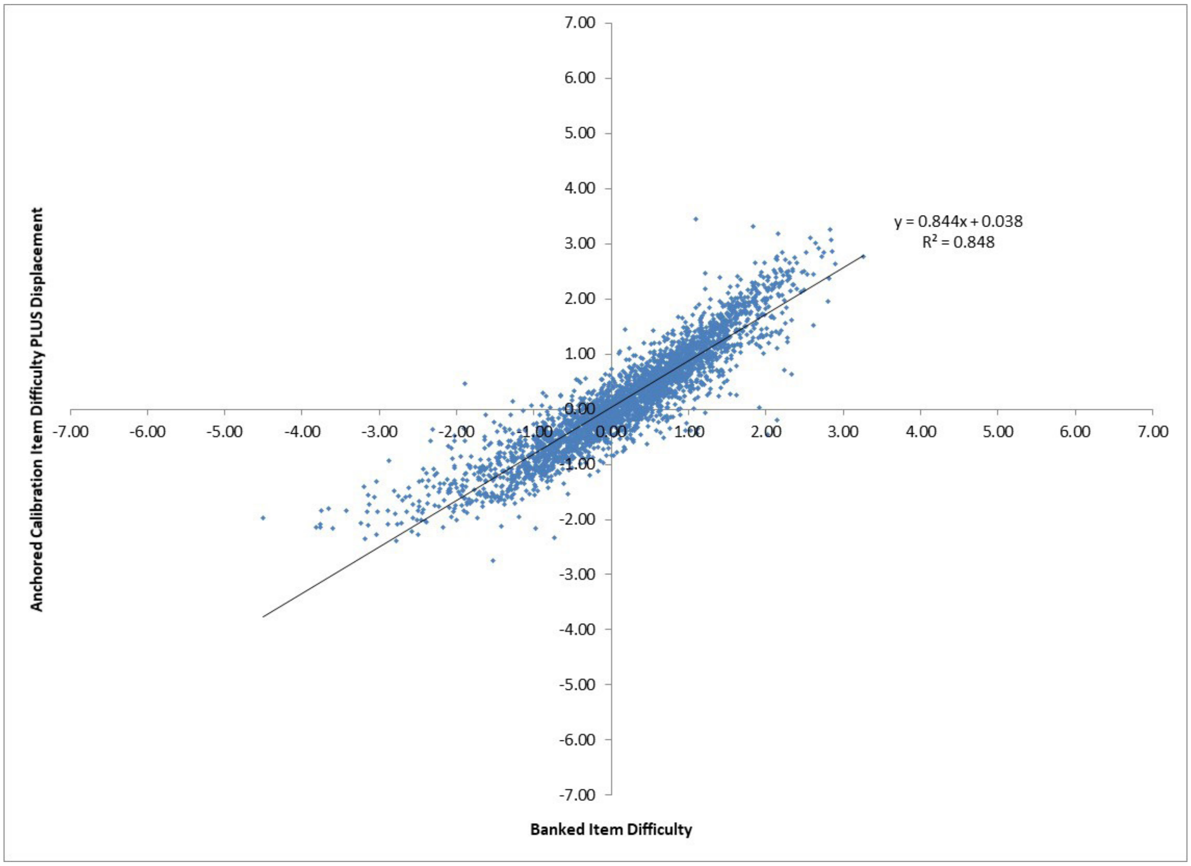
Table 18–17 summarizes the data in Figure 18–21. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-four percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–17).

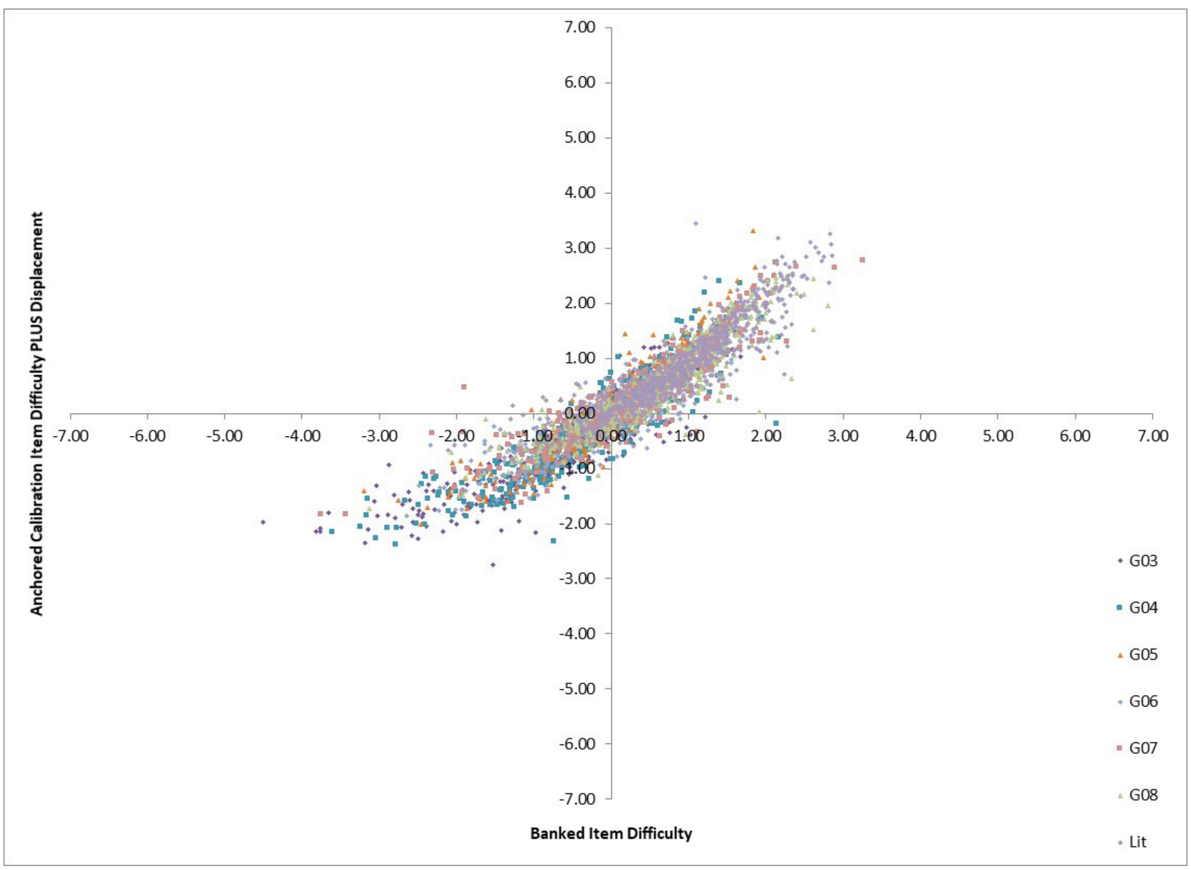
Table 18–17. Number of Reading Items by Grade/Course and Displacement Interval

Interval	G03	G04	G05	G06	G07	G08	LIT	Total
Disp. ≤ -1.0	7	3	0	4	3	8	2	27
-1.0 < Disp. ≤ -0.9	4	5	1	0	6	2	1	19
-0.9 < Disp. ≤ -0.8	3	4	1	4	0	1	8	21
-0.8 < Disp. ≤ -0.7	6	5	0	5	4	9	11	40
-0.7 < Disp. ≤ -0.6	5	9	1	11	4	12	12	54
-0.6 < Disp. ≤ -0.5	10	9	6	11	11	7	16	70
-0.5 < Disp. ≤ -0.4	18	15	11	19	27	21	20	131
-0.4 < Disp. ≤ -0.3	31	24	14	24	27	30	47	197
-0.3 < Disp. ≤ -0.2	28	37	34	51	46	46	56	298
-0.2 < Disp. ≤ -0.1	59	30	45	55	48	41	88	366
-0.1 < Disp. ≤ 0.0	44	47	46	65	55	54	112	423
0.0 < Disp. ≤ 0.1	53	45	48	82	77	60	112	477
0.1 < Disp. ≤ 0.2	37	43	42	42	57	53	72	346
0.2 < Disp. ≤ 0.3	19	26	34	35	23	42	51	230
0.3 < Disp. ≤ 0.4	24	27	23	16	25	28	31	174
0.4 < Disp. ≤ 0.5	9	11	15	15	15	11	24	100
0.5 < Disp. ≤ 0.6	19	5	14	18	15	4	15	90
0.6 < Disp. ≤ 0.7	9	12	5	6	5	5	13	55
0.7 < Disp. ≤ 0.8	6	8	8	5	2	2	3	34
0.8 < Disp. ≤ 0.9	5	3	2	2	4	3	3	22
0.9 < Disp. ≤ 1.0	4	3	1	4	1	2	2	17
1.0 < Disp.	17	9	7	9	8	4	9	63
TOTAL	417	380	358	483	463	445	708	3254

Figure 18–22 mirrors Figure 18–20, except the calibrations exclude items with fewer than 100 administrations. Again, a line of best fit is included in the upper plot.

Figure 18–22. Reading Banked Item Parameters vs. Anchored Grade Level Calibrations — All Items in Grade 3 and Above with N>100





For the two sets of anchored grade level calibrations described above, banked item parameters were compared to the newly calibrated values by calculating a robust Z statistic for each item pairing. If item difficulties from the operational calibration are close to the banked values, the correlation will be high and the additive constant near zero. Table 18–18 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in the calibrations.

Table 18–18. Summary of Robust Z across Two Sets of Anchored Grade Level Calibrations in Reading

Grade/ Course	Cal 1: Number of Items	Cal 1: Number of Items with ABS(Z) > 1.645	Cal 1: Percent of Items with ABS(Z) > 1.645	Cal 2: Number of Items	Cal 2: Number of Items with ABS(Z) > 1.645	Cal 2: Percent of Items with ABS(Z) > 1.645
Kindergarten	0	0	N/A	0	0	N/A
Grade 1	0	0	N/A	0	0	N/A
Grade 2	0	0	N/A	0	0	N/A
Grade 3	427	98	23%	417	96	23%
Grade 4	439	89	20%	380	79	21%
Grade 5	387	56	14%	358	49	14%
Grade 6	496	85	17%	483	82	17%
Grade 7	472	69	15%	463	70	15%
Grade 8	471	64	14%	445	61	14%
Literature	711	99	14%	708	99	14%
Total	3403	560	16%	3254	536	16%
	Correlation = 0.920			Correlation = 0.921		
	Additive Constant = 0.007			Additive Constant = 0.006		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, in calibration 1, all items with absolute displacement greater than 0.496 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.491 to 0.496, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.491 have absolute value of robust Z greater than 1.645.

SCIENCE

Figure 18–23 shows the displacements from the anchored grade level calibrations of operational data for the science item bank. Items are color-coded by grade/course.

Figure 18–23. Science Anchored Grade Level Calibrations Displacements — All Items in Grade 3 and Above

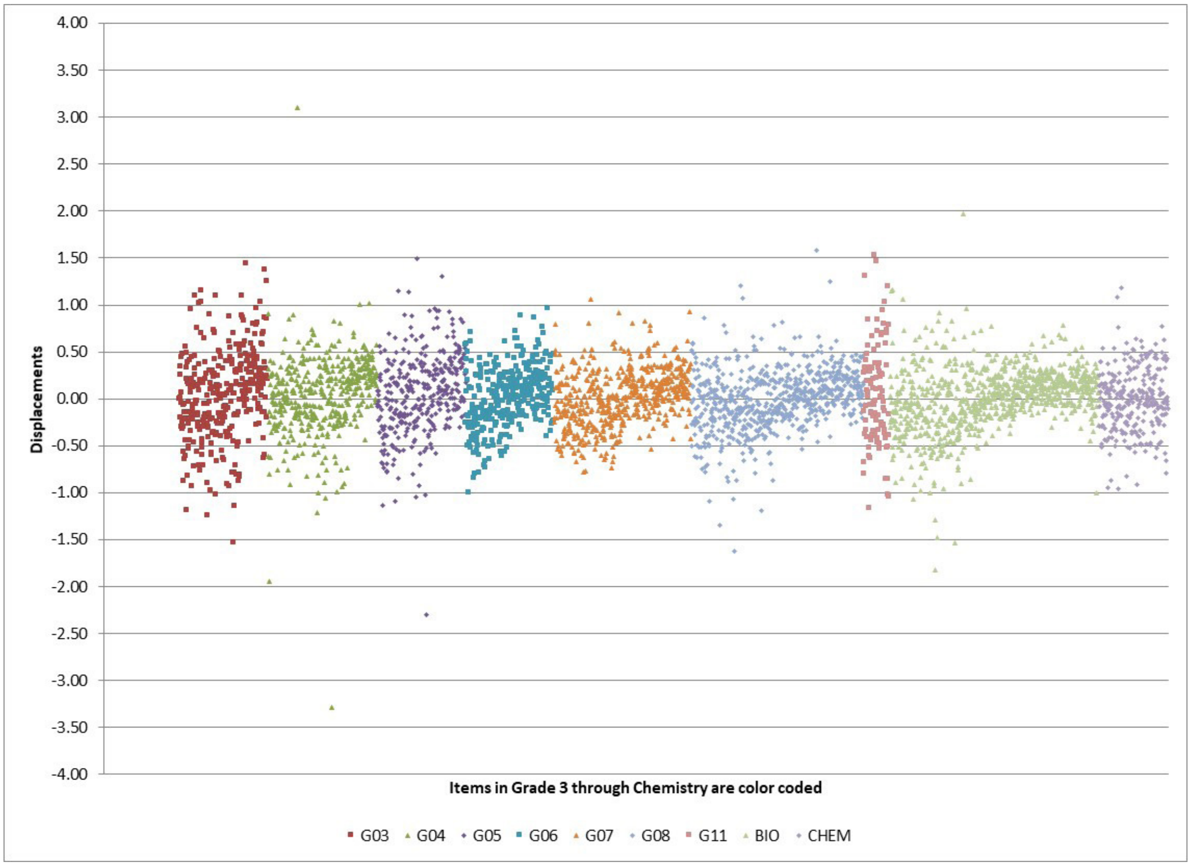


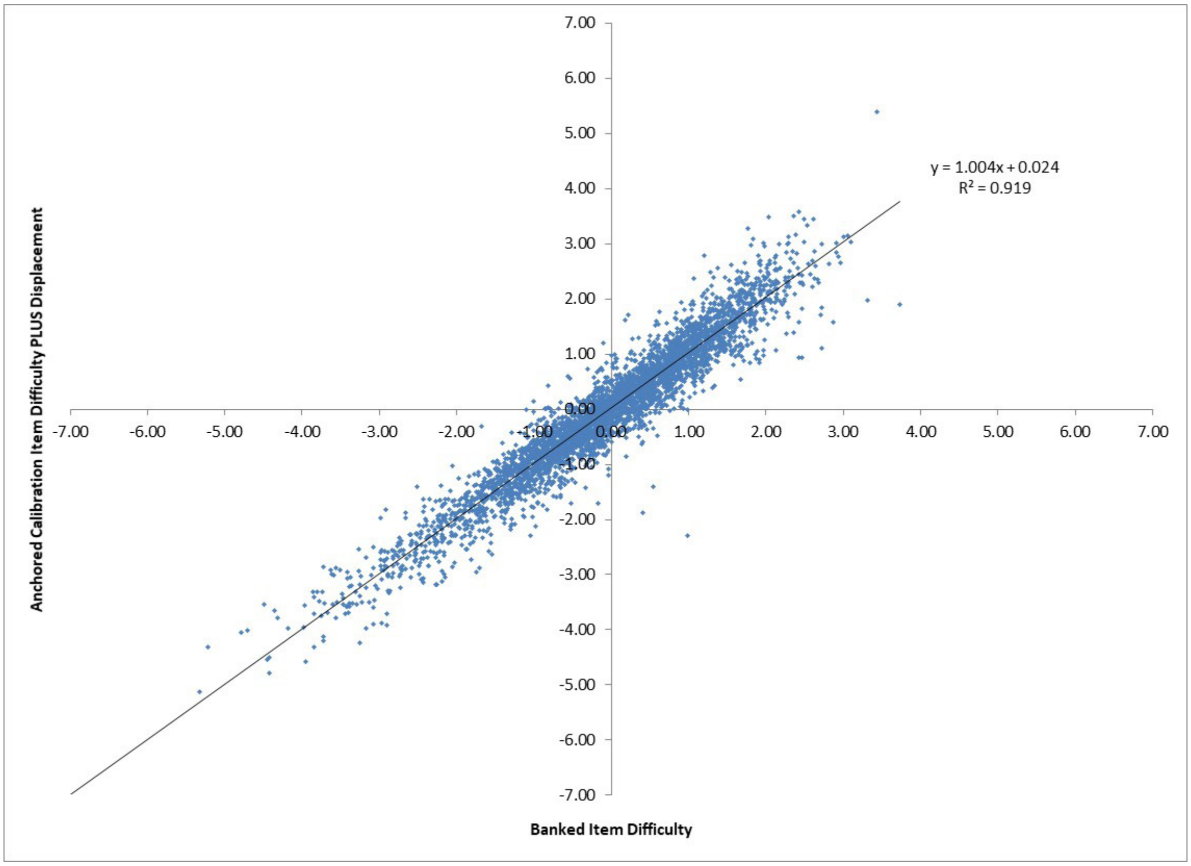
Table 18–19 summarizes the data in Figure 18–23. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-six percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–19).

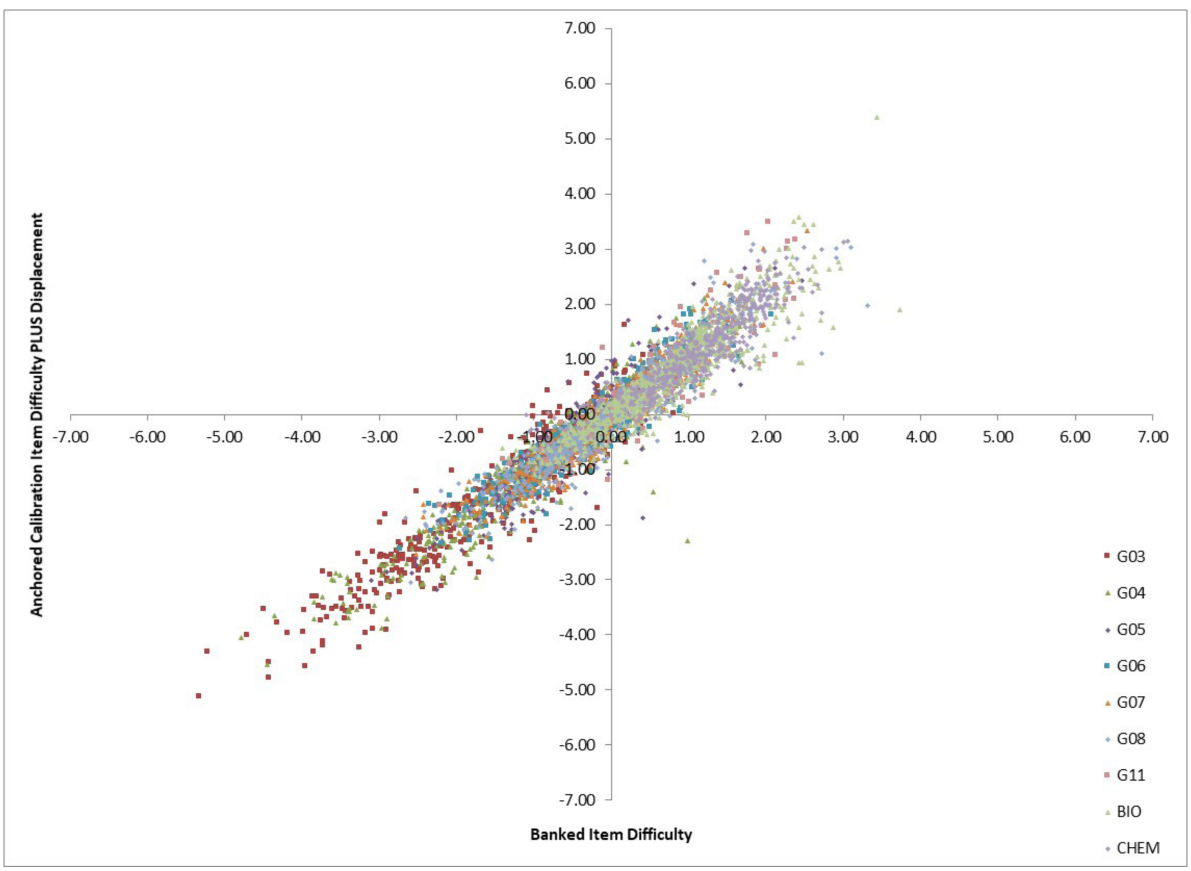
Table 18–19. Number of Science Items by Grade/Course and Displacement Interval

Interval	G03	G04	G05	G06	G07	G08	G11	BIO	CHEM	Total
Disp. ≤ -1.0	5	5	5	0	0	5	3	6	0	29
-1.0 < Disp. ≤ -0.9	5	4	1	1	0	0	0	5	3	19
-0.9 < Disp. ≤ -0.8	6	4	2	2	0	4	3	6	2	29
-0.8 < Disp. ≤ -0.7	7	5	4	3	3	6	0	4	1	33
-0.7 < Disp. ≤ -0.6	9	9	5	4	8	7	3	9	3	57
-0.6 < Disp. ≤ -0.5	8	5	14	10	14	13	4	25	8	101
-0.5 < Disp. ≤ -0.4	15	10	8	13	25	26	7	23	20	147
-0.4 < Disp. ≤ -0.3	16	20	21	13	34	33	10	41	21	209
-0.3 < Disp. ≤ -0.2	29	32	25	34	36	62	5	56	31	310
-0.2 < Disp. ≤ -0.1	30	42	32	44	63	81	8	73	39	412
-0.1 < Disp. ≤ 0.0	26	47	35	35	61	88	8	113	57	470
0.0 < Disp. ≤ 0.1	29	38	31	40	77	99	7	108	74	503
0.1 < Disp. ≤ 0.2	38	54	38	48	78	86	5	137	49	533
0.2 < Disp. ≤ 0.3	24	50	30	40	50	70	10	90	27	391
0.3 < Disp. ≤ 0.4	29	40	34	19	44	38	7	54	29	294
0.4 < Disp. ≤ 0.5	18	28	18	16	19	27	2	26	25	179
0.5 < Disp. ≤ 0.6	14	15	13	8	14	12	4	11	14	105
0.6 < Disp. ≤ 0.7	8	7	9	6	2	6	4	9	10	61
0.7 < Disp. ≤ 0.8	7	2	5	3	3	3	4	8	4	39
0.8 < Disp. ≤ 0.9	8	4	6	2	3	2	2	2	3	32
0.9 < Disp. ≤ 1.0	2	1	5	1	2	0	1	2	1	15
1.0 < Disp.	10	3	4	0	1	4	5	4	2	33
TOTAL	343	425	345	342	537	672	102	812	423	4001

Figure 18–24 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored grade level calibrations of all items using the operational data set. Again, a line of best fit is included in the upper plot.

Figure 18–24. Science Banked Item Parameters vs. Anchored Grade Level Calibrations — All Items in Grade 3 and Above





An examination of the items with larger differences between banked values and operational estimates revealed that a number of these have low *n*-counts in the operational calibration. To investigate whether this had an impact on the stability of the item parameter estimates, anchored grade level calibrations of all items in grade 3 and above with larger *n*-counts were run. Figure 18–25 shows the displacements from these calibrations. Items are color-coded by grade/course.

Figure 18–25. Science Anchored Grade Level Calibrations Displacements — All Items in Grade 3 and Above with N>100

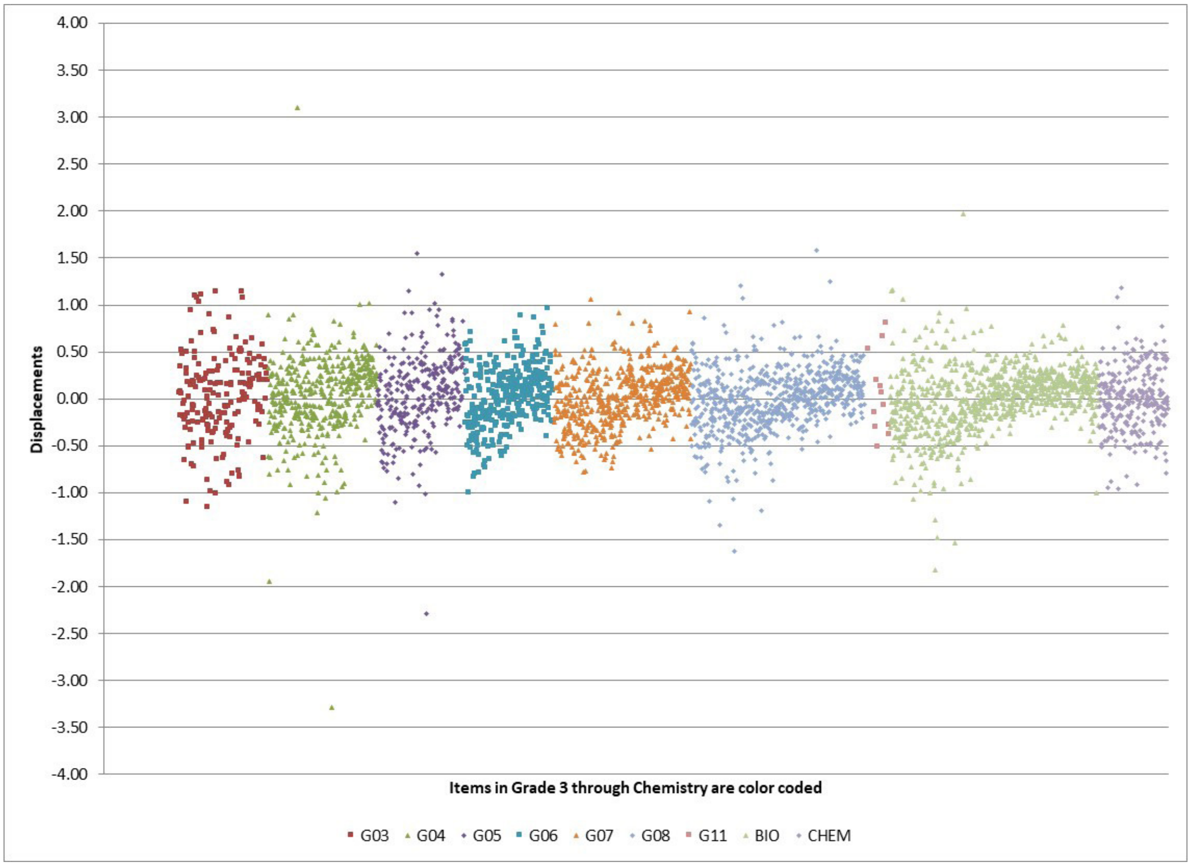


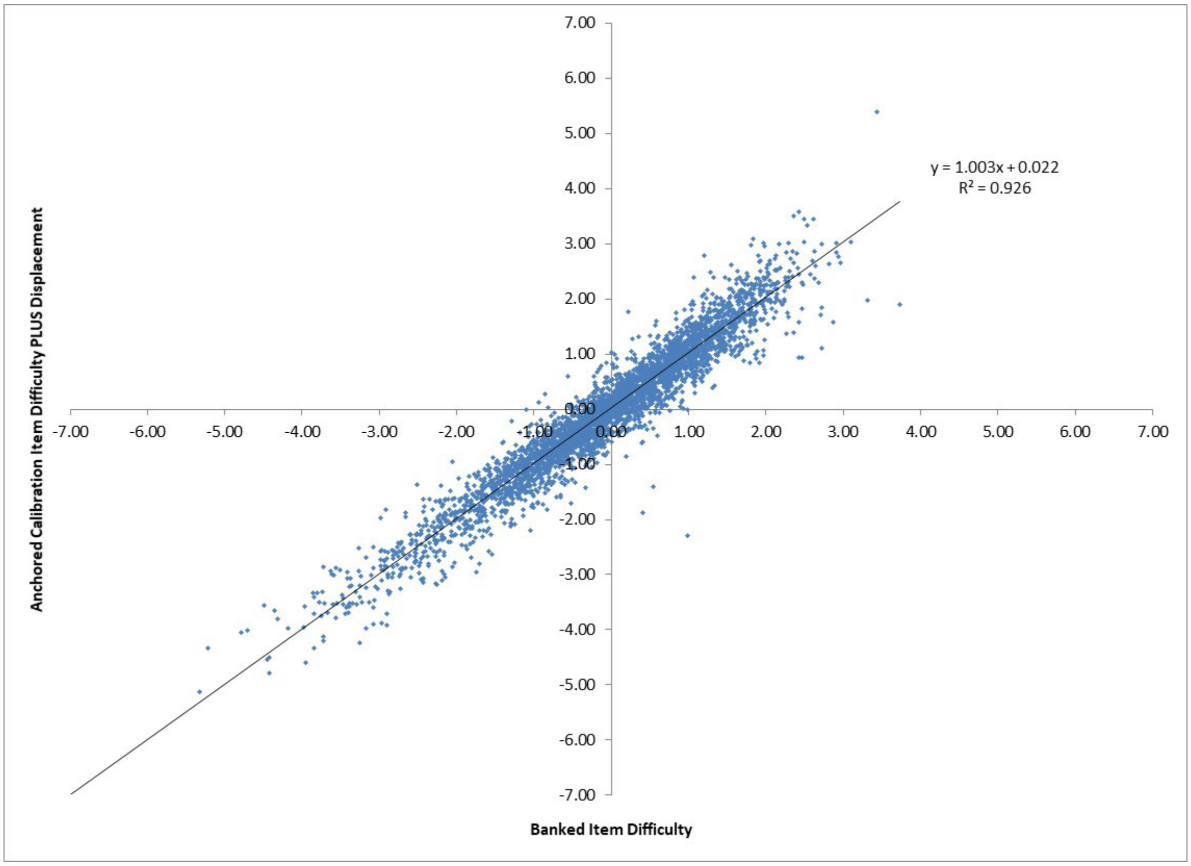
Table 18–20 summarizes the data in Figure 18–25. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-seven percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–20).

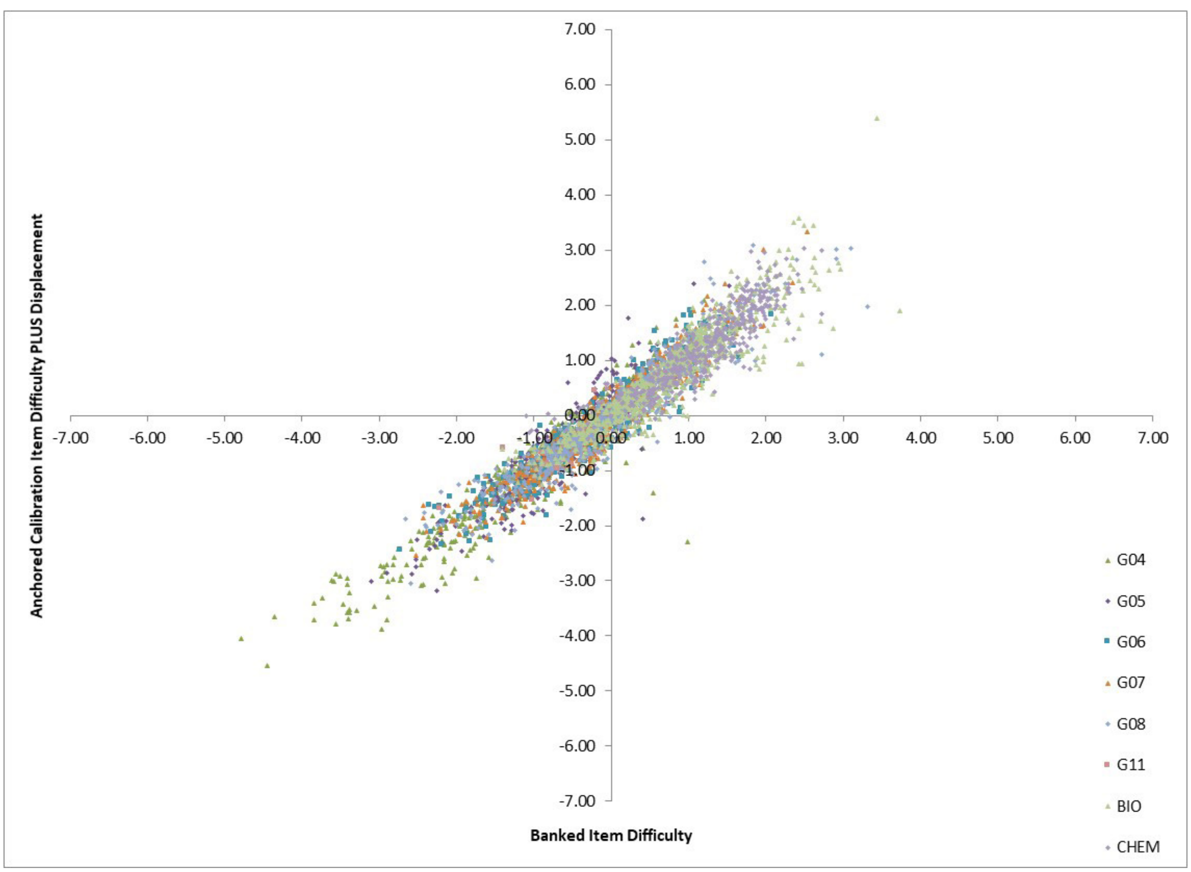
Table 18–20. Number of Science Items by Grade/Course and Displacement Interval

Interval	G03	G04	G05	G06	G07	G08	G11	BIO	CHEM	Total
Disp. ≤ -1.0	3	4	3	0	0	5	0	6	0	21
-1.0 < Disp. ≤ -0.9	2	5	1	1	0	0	0	5	3	17
-0.9 < Disp. ≤ -0.8	4	4	2	2	0	4	0	6	2	24
-0.8 < Disp. ≤ -0.7	4	4	3	3	3	6	0	4	1	28
-0.7 < Disp. ≤ -0.6	5	9	5	4	8	7	0	9	3	50
-0.6 < Disp. ≤ -0.5	3	5	12	10	14	13	1	25	8	91
-0.5 < Disp. ≤ -0.4	9	9	8	13	25	26	0	23	20	133
-0.4 < Disp. ≤ -0.3	10	20	15	12	34	33	2	41	19	186
-0.3 < Disp. ≤ -0.2	16	33	20	33	36	62	1	56	31	288
-0.2 < Disp. ≤ -0.1	21	42	29	44	63	81	1	73	38	392
-0.1 < Disp. ≤ 0.0	18	47	31	35	59	88	1	113	58	450
0.0 < Disp. ≤ 0.1	14	37	31	40	78	98	1	108	72	479
0.1 < Disp. ≤ 0.2	27	55	34	48	79	85	2	137	48	515
0.2 < Disp. ≤ 0.3	16	50	26	40	50	71	0	90	26	369
0.3 < Disp. ≤ 0.4	8	39	31	19	44	38	0	54	29	262
0.4 < Disp. ≤ 0.5	13	28	12	15	19	27	0	26	25	165
0.5 < Disp. ≤ 0.6	7	14	12	8	14	12	1	11	14	93
0.6 < Disp. ≤ 0.7	4	7	8	6	1	6	1	9	10	52
0.7 < Disp. ≤ 0.8	3	3	3	3	3	3	0	8	4	30
0.8 < Disp. ≤ 0.9	2	4	4	2	3	2	1	2	3	23
0.9 < Disp. ≤ 1.0	1	0	4	1	2	0	0	2	1	11
1.0 < Disp.	7	3	4	0	1	4	0	4	2	25
TOTAL	197	422	298	339	536	671	12	812	417	3704

Figure 18–26 mirrors Figure 18–24, except the calibrations exclude items with fewer than 100 administrations. Again, a line of best fit is included in the upper plot.

Figure 18–26. Science Banked Item Parameters vs. Anchored Grade Level Calibrations — All Items in Grade 3 and Above with N>100





For the two sets of anchored grade level calibrations described above, banked item parameters were compared to the newly calibrated values by calculating a robust Z statistic for each item pairing. If item difficulties from the operational calibration are close to the banked values, the correlation will be high and the additive constant near zero. Table 18–21 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in the calibrations.

Table 18–21. Summary of Robust Z across Two Sets of Anchored Grade Level Calibrations in Science

Grade/ Course	Cal 1: Number of Items	Cal 1: Number of Items with ABS(Z) > 1.645	Cal 1: Percent of Items with ABS(Z) > 1.645	Cal 2: Number of Items	Cal 2: Number of Items with ABS(Z) > 1.645	Cal 2: Percent of Items with ABS(Z) > 1.645
K–2 span	0	0	N/A	0	0	N/A
Grade 3	343	89	26%	197	47	24%
Grade 4	425	62	15%	422	65	15%
Grade 5	345	70	20%	298	62	21%
Grade 6	342	42	12%	339	45	13%
Grade 7	537	50	9%	536	61	11%
Grade 8	672	62	9%	671	72	11%
Grade 11	102	34	33%	12	4	33%
Biology	812	95	12%	812	101	12%
Chemistry	423	52	12%	417	59	14%
Total	4001	556	14%	3704	516	14%
	Correlation = 0.959			Correlation = 0.962		
	Additive Constant = 0.024			Additive Constant = 0.022		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, in calibration 1, all items with absolute displacement greater than 0.537 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.464 to 0.537, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.464 have absolute value of robust Z greater than 1.645.

WRITING/ENGLISH COMPOSITION

Figure 18–27 shows the displacements from the anchored grade level calibrations of operational data for the writing item bank. Items are color-coded by grade/course.

Figure 18–27. Writing Anchored Grade Level Calibrations Displacements — All Items in Grade 3 and Above

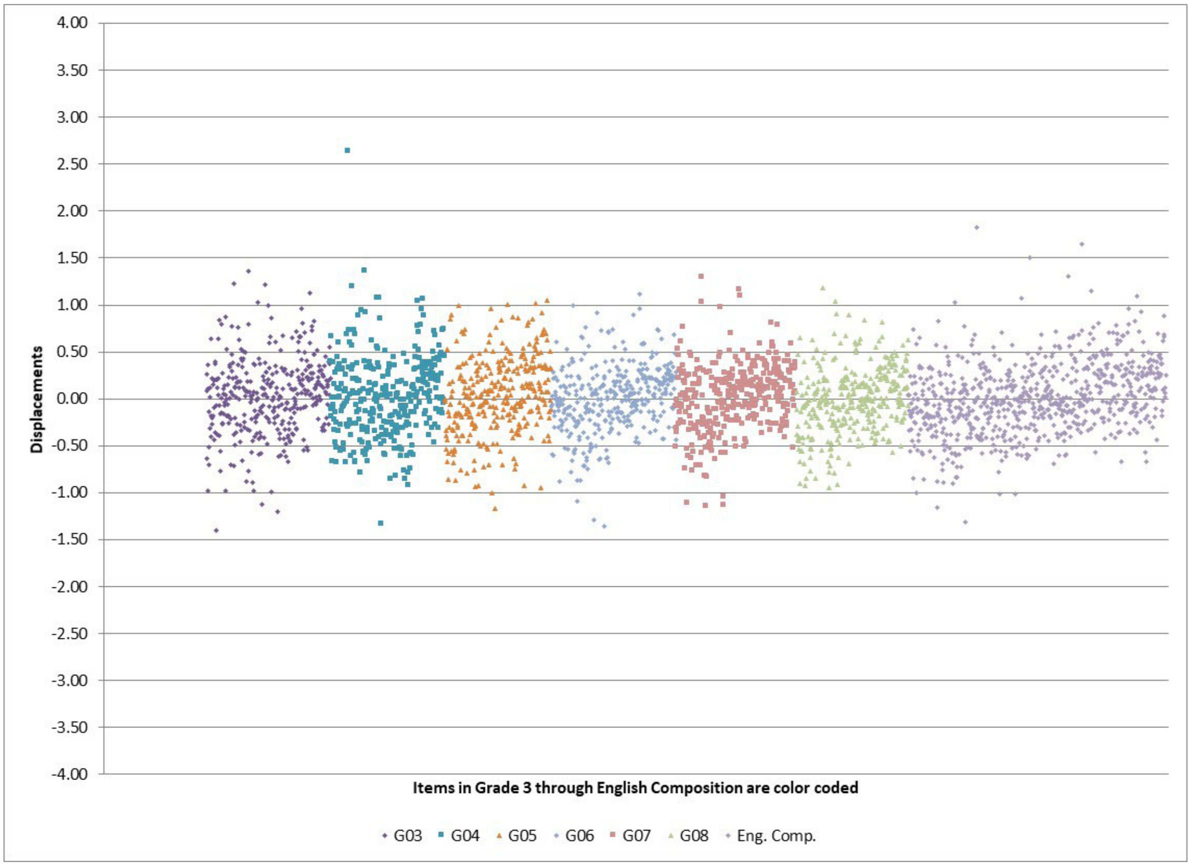


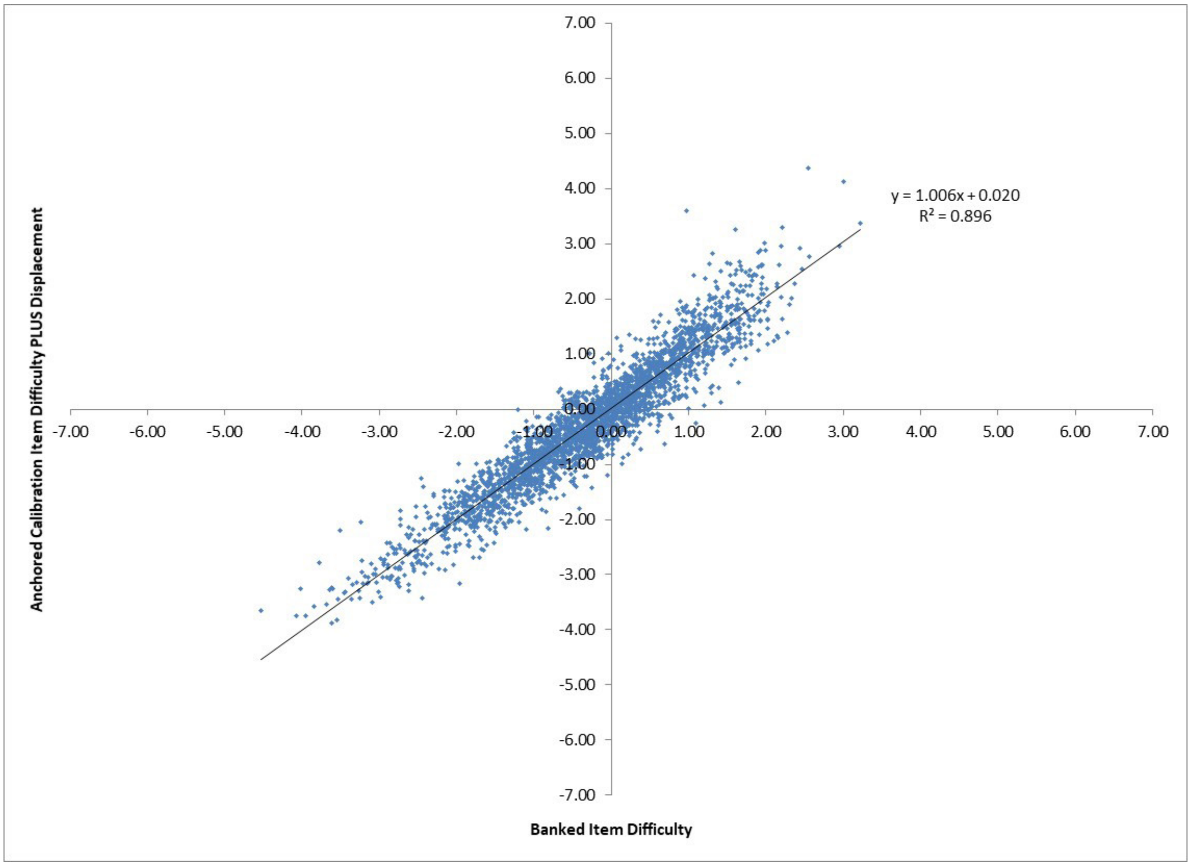
Table 18–22 summarizes the data in Figure 18–27. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-two percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–22).

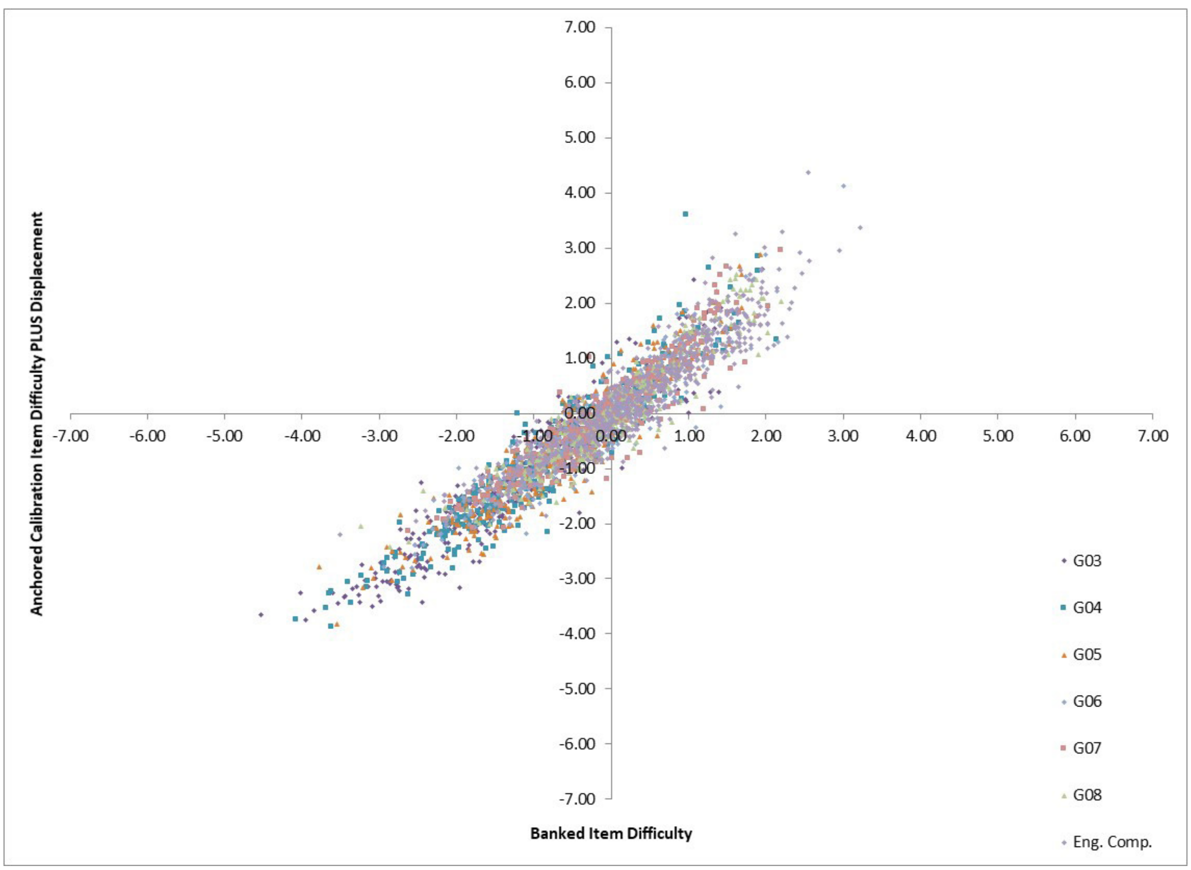
Table 18–22. Number of Writing Items by Grade/Course and Displacement Interval

Interval	G03	G04	G05	G06	G07	G08	COMP	Total
Disp. ≤ -1.0	3	1	2	3	4	0	4	17
-1.0 < Disp. ≤ -0.9	4	1	4	0	0	3	2	14
-0.9 < Disp. ≤ -0.8	2	3	2	3	3	3	6	22
-0.8 < Disp. ≤ -0.7	4	4	7	4	4	4	4	31
-0.7 < Disp. ≤ -0.6	7	12	5	9	3	7	15	58
-0.6 < Disp. ≤ -0.5	9	18	10	12	15	11	29	104
-0.5 < Disp. ≤ -0.4	17	13	11	11	12	23	34	121
-0.4 < Disp. ≤ -0.3	24	23	19	17	16	13	47	159
-0.3 < Disp. ≤ -0.2	26	27	16	28	35	31	51	214
-0.2 < Disp. ≤ -0.1	24	32	34	38	24	25	88	265
-0.1 < Disp. ≤ 0.0	35	28	33	39	40	49	94	318
0.0 < Disp. ≤ 0.1	42	37	30	48	37	31	75	300
0.1 < Disp. ≤ 0.2	45	30	29	43	56	45	62	310
0.2 < Disp. ≤ 0.3	35	18	20	43	35	23	67	241
0.3 < Disp. ≤ 0.4	28	36	32	26	29	18	57	226
0.4 < Disp. ≤ 0.5	12	13	16	12	17	16	35	121
0.5 < Disp. ≤ 0.6	7	9	11	7	9	8	17	68
0.6 < Disp. ≤ 0.7	13	5	9	6	2	9	20	64
0.7 < Disp. ≤ 0.8	8	8	6	7	2	0	12	43
0.8 < Disp. ≤ 0.9	5	3	7	1	1	3	4	24
0.9 < Disp. ≤ 1.0	2	3	3	3	1	1	2	15
1.0 < Disp.	5	7	3	1	4	2	8	30
TOTAL	357	331	309	361	349	325	733	2765

Figure 18–28 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored grade level calibrations of all items using the operational data set. Again, a line of best fit is included in the upper plot.

Figure 18–28. Writing Banked Item Parameters vs. Anchored Grade Level Calibrations — All Items in Grade 3 and Above





An examination of the items with larger differences between banked values and operational estimates revealed that a number of these have low *n*-counts in the operational calibration. To investigate whether this had an impact on the stability of the item parameter estimates, anchored grade level calibrations of all items in grade 3 and above with larger *n*-counts were run. Figure 18–29 shows the displacements from these calibrations. Items are color-coded by grade/course.

Figure 18–29. Writing Anchored Grade Level Calibrations Displacements — All Items in Grade 3 and Above with *N*>100

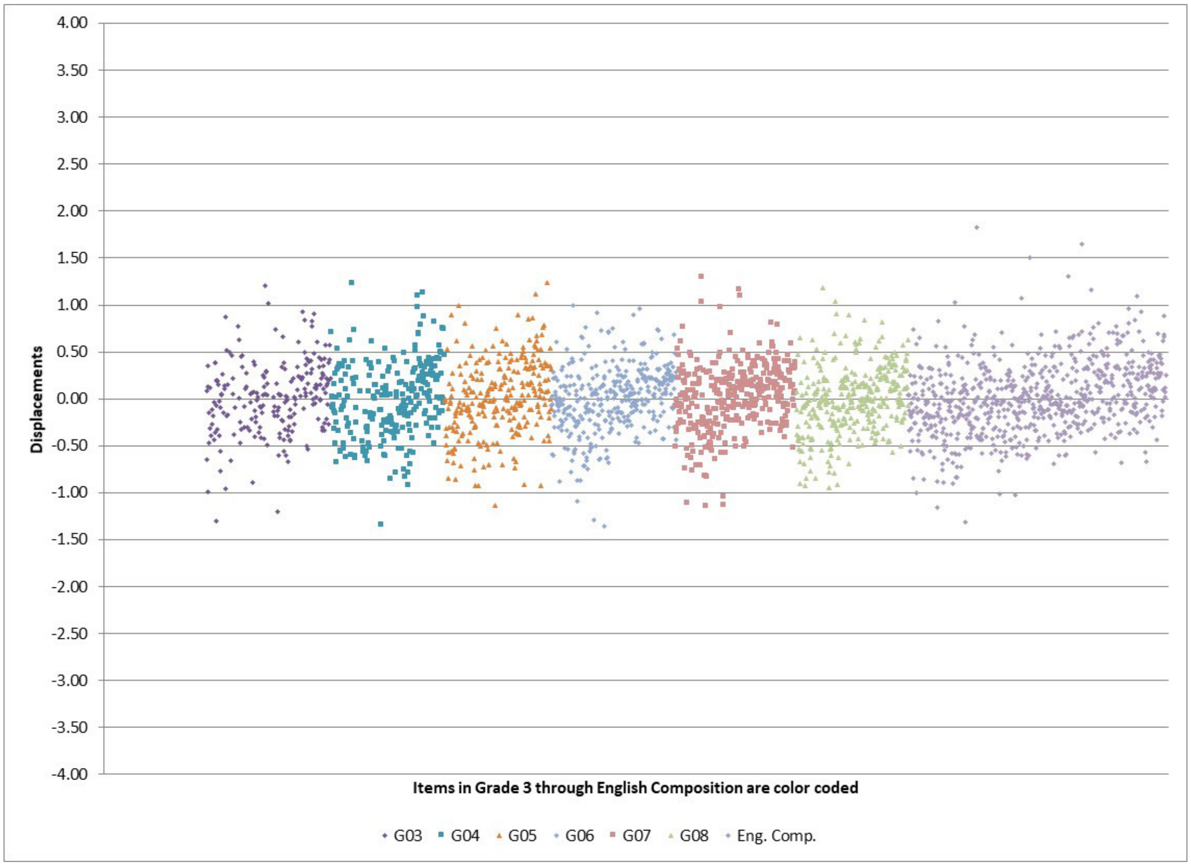


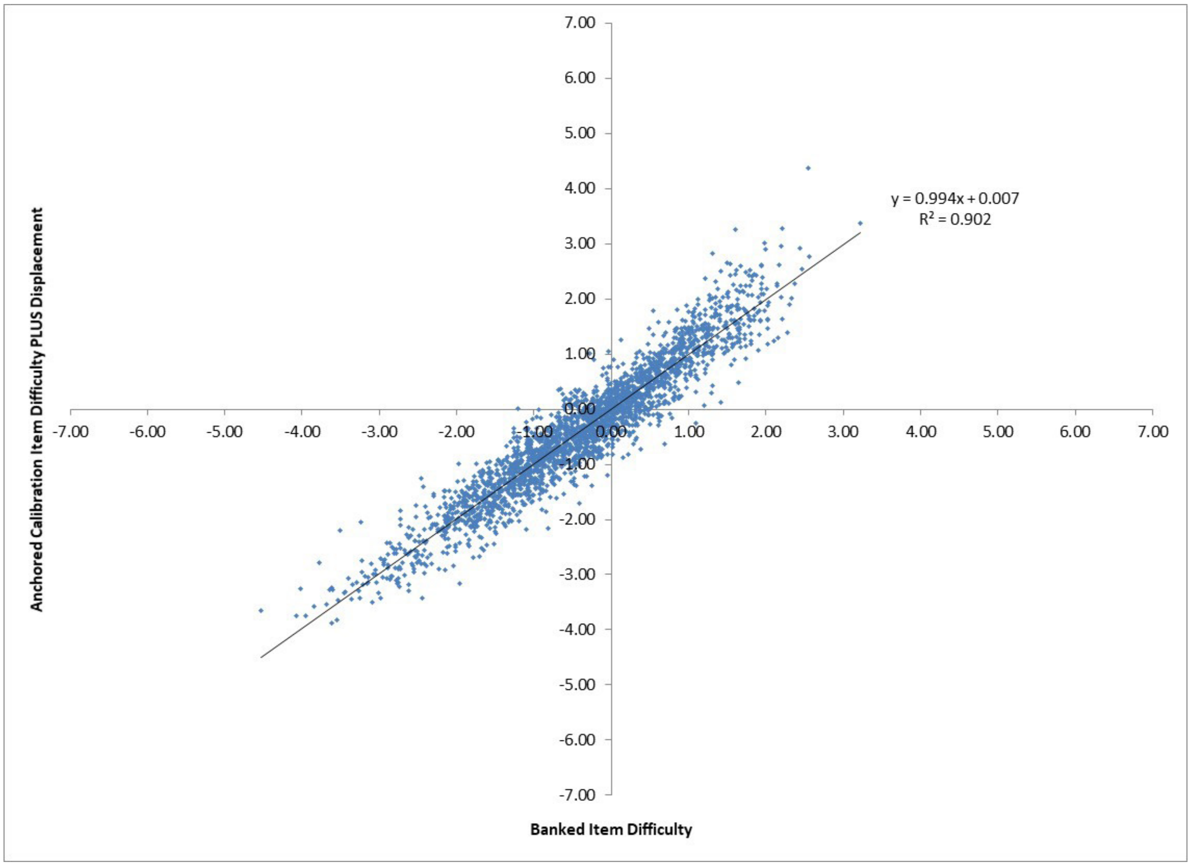
Table 18–23 summarizes the data in Figure 18–29. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-three percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–23).

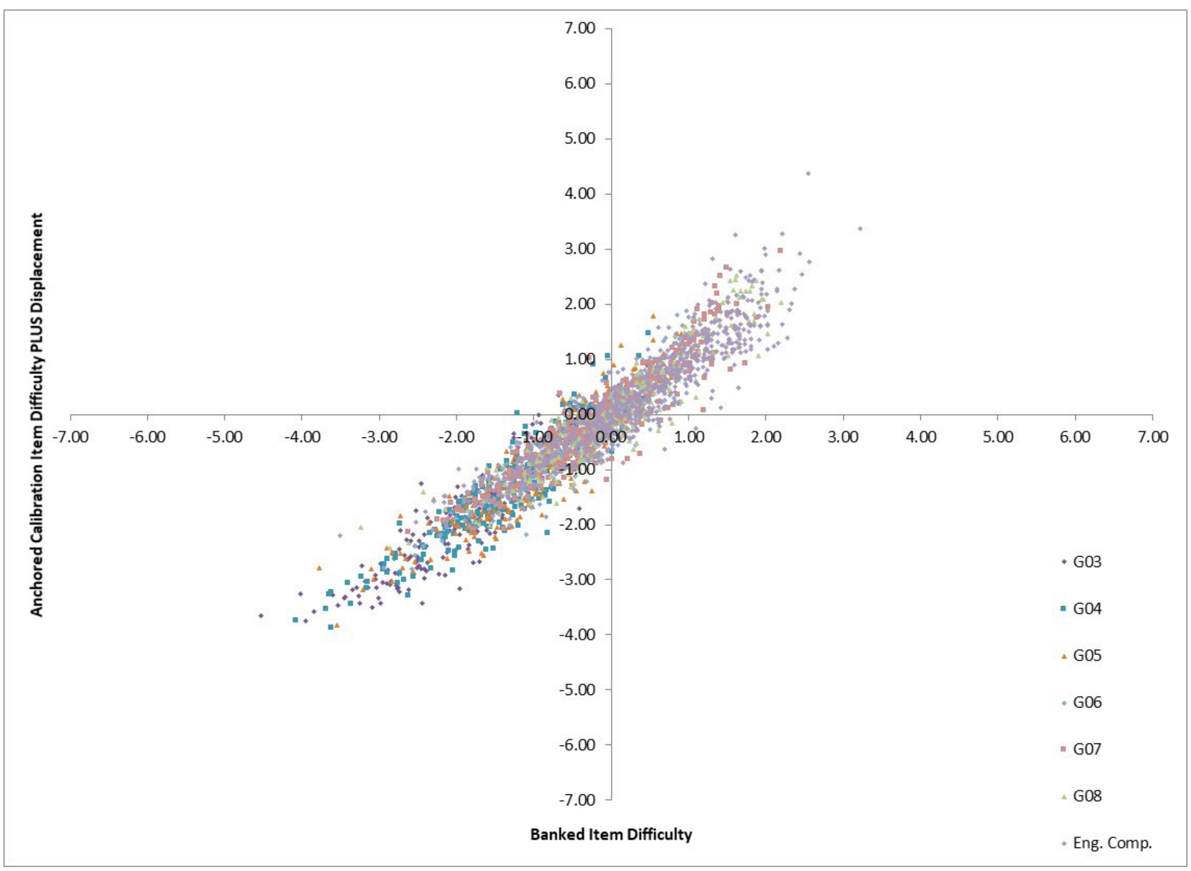
Table 18–23. Number of Writing Items by Grade/Course and Displacement Interval

Interval	G03	G04	G05	G06	G07	G08	COMP	Total
Disp. ≤ -1.0	2	1	1	3	4	0	4	15
-1.0 < Disp. ≤ -0.9	2	1	4	0	0	3	1	11
-0.9 < Disp. ≤ -0.8	1	2	2	3	3	3	7	21
-0.8 < Disp. ≤ -0.7	1	3	6	4	4	4	4	26
-0.7 < Disp. ≤ -0.6	4	11	5	9	3	7	13	52
-0.6 < Disp. ≤ -0.5	4	13	8	12	15	11	29	92
-0.5 < Disp. ≤ -0.4	11	10	12	11	12	23	32	111
-0.4 < Disp. ≤ -0.3	21	17	16	17	16	13	49	149
-0.3 < Disp. ≤ -0.2	12	20	15	28	35	31	48	189
-0.2 < Disp. ≤ -0.1	17	27	28	38	24	25	90	249
-0.1 < Disp. ≤ 0.0	23	18	35	39	40	49	88	292
0.0 < Disp. ≤ 0.1	28	29	23	47	37	31	75	270
0.1 < Disp. ≤ 0.2	27	20	23	44	56	45	61	276
0.2 < Disp. ≤ 0.3	20	21	17	43	35	23	64	223
0.3 < Disp. ≤ 0.4	16	24	24	26	29	18	56	193
0.4 < Disp. ≤ 0.5	12	11	14	12	17	16	33	115
0.5 < Disp. ≤ 0.6	4	5	12	7	9	8	17	62
0.6 < Disp. ≤ 0.7	4	4	6	6	2	9	20	51
0.7 < Disp. ≤ 0.8	3	5	3	7	2	0	11	31
0.8 < Disp. ≤ 0.9	3	2	5	1	1	3	5	20
0.9 < Disp. ≤ 1.0	2	1	1	3	1	1	2	11
1.0 < Disp.	2	3	2	0	4	2	8	21
TOTAL	219	248	262	360	349	325	717	2480

Figure 18–30 mirrors Figure 18–28, except the calibrations exclude items with fewer than 100 administrations. Again, a line of best fit is included in the upper plot.

Figure 18–30. Writing Banked Item Parameters vs. Anchored Grade Level Calibrations — All Items in Grade 3 and Above with *N*>100





For the two sets of anchored grade level calibrations described above, banked item parameters were compared to the newly calibrated values by calculating a robust Z statistic for each item pairing. If item difficulties from the operational calibration are close to the banked values, the correlation will be high and the additive constant near zero. Table 18–24 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in the calibrations.

Table 18–24. Summary of Robust Z across Two Sets of Anchored Grade Level Calibrations in Writing

Grade/ Course	Cal 1: Number of Items	Cal 1: Number of Items with ABS(Z) > 1.645	Cal 1: Percent of Items with ABS(Z) > 1.645	Cal 2: Number of Items	Cal 2: Number of Items with ABS(Z) > 1.645	Cal 2: Percent of Items with ABS(Z) > 1.645
Kindergarten	0	0	N/A	0	0	N/A
Grade 1	0	0	N/A	0	0	N/A
Grade 2	0	0	N/A	0	0	N/A
Grade 3	357	57	16%	219	26	12%
Grade 4	331	55	17%	248	38	15%
Grade 5	309	54	17%	262	39	15%
Grade 6	361	42	12%	360	43	12%
Grade 7	349	31	9%	349	33	9%
Grade 8	325	36	11%	325	37	11%
English Comp	733	93	13%	717	96	13%
Total	2765	368	13%	2480	312	13%
	Correlation = 0.947			Correlation = 0.950		
	Additive Constant = 0.018			Additive Constant = 0.009		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, in calibration 1, all items with absolute displacement greater than 0.592 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.556 to 0.592, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.556 have absolute value of robust Z greater than 1.645.

For each of the content areas, it is evident from this series of plots that the item parameter estimates are reasonably stable for the items in grade 3 and above.

CHAPTER NINETEEN: REVISION OF BENCHMARK CUTS

As described in Chapter Fourteen, CDT scores are placed along a continuum from “Areas of Need” to “Strengths to Build On.” These are represented in the dynamic reporting suite with colors red, green, and blue. “Areas of Need” are depicted in the red range, while “Strengths to Build On” are depicted in the green and blue ranges. The center of the green range for grades 5 and above was established by panels of Pennsylvania educators during preliminary benchmarking activities (see Chapter Ten for details). The center of the green range for grades 2 through 4 was extrapolated from grades 5 and above prior to the launch of the CDT tests for students in grades 3 through 5 in spring of 2014.

The preliminary benchmarking activities took place prior to the first operational administration in each content area so that, once operational, immediate score reports would be available to students and teachers. Given that the preliminary benchmark cuts were set prior to the operational administration and based on field-test data, it was planned at that time to revisit the location of the cut scores after enough operational data had been collected. The preliminary benchmark cut points in the mathematics content area were analyzed and revised based on operational data following the 2010–2011 school year. The preliminary benchmark cut points in the reading, science, and writing content areas were analyzed and revised based on operational data following the 2011–2012 school year.

The introduction of CDT tests for students in grades 3 through 5 in spring 2014 required benchmark cuts for grades 2 through 4. For each content area, the benchmark cuts in place for the 2013–2014 school year in grades 5 and above were used to extrapolate cuts in grades 2 through 4.

Prior to the start of the 2015–2016 school year, the benchmark cut points in mathematics, reading, and writing were revised based on the revised Pennsylvania System of School Assessments (PSSA) tests and cut points established in spring 2015.

This chapter summarizes changes to the benchmark cuts.

FIRST REVISION OF BENCHMARK CUTS BASED ON OPERATIONAL DATA

In each content area, the benchmark cut points set during preliminary benchmarking activities were analyzed based on matched data sets – operational CDT with PSSA and Keystone Exams (Keystone). CDT benchmark cuts were not revised to exactly match PSSA and Keystone cuts or be predictive. However, CDT, PSSA, and Keystone are based on the same eligible content. As such, it is reasonable to expect that students who do well on CDT will do well on PSSA/Keystone and vice versa. In looking at CDT results matched to PSSA and Keystone results it was determined that many students who scored in the CDT red range scored Proficient or Advanced on PSSA or Keystone suggesting that CDT benchmark cuts were set too high. Therefore, CDT benchmark cuts were lowered to make CDT red/green/blue classifications more consistent with PSSA and Keystone results. See Chapter Nineteen of the 2010–2011 and 2011–2012 technical reports for details. Table 19–1 provides a summary of the first revisions to the benchmark cut points.

Table 19–1. Summary of First Revision to Benchmark Cuts

Content Area	Course /Grade	Benchmarking Logit Cut Point	First Revision to Logit Cut Point	Difference in Logit Cut Point	Difference in Scale Score
Mathematics	Grade 5	-0.292	-0.792	-0.500	-63
Mathematics	Grade 6	0.526	0.026	-0.500	-62
Mathematics	Grade 7	1.495	0.495	-1.000	-125
Mathematics	Grade 8	2.238	0.838	-1.400	-175
Mathematics	High School	3.363	1.613	-1.750	-218
Mathematics	Algebra I	3.363	1.613	-1.750	-218
Mathematics	Geometry	3.614	1.864	-1.750	-219
Mathematics	Algebra II	4.117	2.367	-1.750	-219
Reading	Grade 5	1.529	0.529	-1.000	-143
Reading	Grade 6	2.015	1.015	-1.000	-142
Reading	Grade 7	2.299	1.299	-1.000	-143
Reading	Grade 8	2.500	1.500	-1.000	-143
Reading	Literature	2.657	1.657	-1.000	-143
Science	Grade 5	1.099	-0.451	-1.550	-206
Science	Grade 6	1.522	-0.028	-1.550	-206
Science	Grade 7	1.879	0.329	-1.550	-206
Science	Grade 8	2.189	0.639	-1.550	-206
Science	High School	2.462	1.112	-1.350	-179
Science	Biology	2.462	1.112	-1.350	-179
Science	Chemistry	2.706	1.356	-1.350	-179
Writing	Grade 5	0.731	-0.569	-1.300	-173
Writing	Grade 6	1.363	0.063	-1.300	-172
Writing	Grade 7	1.886	0.586	-1.300	-173
Writing	Grade 8	2.219	0.919	-1.300	-173
Writing	English Composition	2.281	0.981	-1.300	-173

EXTRAPOLATION OF BENCHMARK CUTS FOR GRADES 2 THROUGH 4

The introduction of CDT tests for students in grades 3 through 5 in spring 2014 required benchmark cuts for grades 2 through 4[1]. For each content area, the benchmark cuts in place for the 2013–2014 school year in grades 5 and above were used to extrapolate cuts in grades 2 through 4. See Chapter Nineteen of the 2013–2014 technical report for details.

[1] It is not expected that students in grade 2 will use the CDT. However, teachers may want to use a grade 2 benchmark when looking at reports for students in grade 3, especially early in the school year.

REVISION OF BENCHMARK CUTS BASED ON CHANGES TO PSSA

In spring 2015, changes were made to PSSA test designs and cut points in mathematics and English language arts. In light of these changes, CDT benchmark cuts were analyzed again using matched data sets - operational CDT with PSSA and Keystone. The new PSSA cut points approved in July 2015 represented higher, more rigorous, standards. Therefore, CDT benchmark cuts in mathematics, reading, and writing were raised to make CDT red/green/blue classifications more consistent with PSSA. See Chapter Nineteen of the 2015–2016 technical report for details. Table 19–2 provides a summary of the revisions to the benchmark cut points based on changes to PSSA.

Table 19–2. Summary of Second Revision to Benchmark Cuts

CDT	Course /Grade	2014–2015 Logit Cut Point	2015–2016 Logit Cut Point	Difference in Logit Cut Point	Difference in Scale Score
Math Grades 3–5	Grade 2	-2.828	-1.628	1.200	150
Math Grades 3–5	Grade 3	-2.083	-0.883	1.200	150
Math Grades 3–5	Grade 4	-1.380	-0.180	1.200	150
Math Grades 3–5	Grade 5	-0.792	0.208	1.000	125
Math Gr 6–HS	Grade 6	0.026	0.726	0.700	87
Math Gr 6–HS	Grade 7	0.495	1.195	0.700	88
Math Gr 6–HS	Grade 8	0.838	1.513	0.675	84
Math Gr 6–HS	High School	1.613	1.613	0.000	0
Algebra I	Algebra I	1.613	1.613	0.000	0
Geometry	Geometry	1.864	1.864	0.000	0
Algebra II	Algebra II	2.367	2.367	0.000	0
Reading Grades 3–5	Grade 2	-1.136	-0.936	0.200	29
Reading Grades 3–5	Grade 3	-0.367	-0.167	0.200	29
Reading Grades 3–5	Grade 4	0.179	0.429	0.250	36
Reading Grades 3–5	Grade 5	0.529	0.879	0.350	50
Read/Lit Grades 6–HS	Grade 6	1.015	1.265	0.250	35
Read/Lit Grades 6–HS	Grade 7	1.299	1.499	0.200	29
Read/Lit Grades 6–HS	Grade 8	1.500	1.725	0.225	32
Read/Lit Grades 6–HS	Literature	1.657	1.882	0.225	32
Writing Grades 3–5	Grade 2	-2.989	-1.739	1.250	166
Writing Grades 3–5	Grade 3	-1.874	-0.624	1.250	166
Writing Grades 3–5	Grade 4	-1.084	-0.084	1.000	133
Writing Grades 3–5	Grade 5	-0.569	0.281	0.850	113
Writing/Eng Comp Gr 6–HS	Grade 6	0.063	0.563	0.500	66
Writing/Eng Comp Gr 6–HS	Grade 7	0.586	0.836	0.250	33
Writing/Eng Comp Gr 6–HS	Grade 8	0.919	0.919	0.000	0
Writing/Eng Comp Gr 6–HS	English Composition	0.981	0.981	0.000	0

BENCHMARK CUTS FOR ALL GRADES AND COURSES FOR THE 2021–2022 SCHOOL YEAR

Table 19–3 shows the benchmark cuts used for student reporting during the 2021–2022 school year in the logit metric for each content area. Also presented are the scale score ranges for each color on the CDT reports.

Table 19–3. Benchmark Cuts and Scale Score Ranges for the 2021–2022 School Year

CDT	Course/Grade	Logit Cut Point (Center of Green)	Red Scale Score Range	Green Scale Score Range	Blue Scale Score Range
Math Grades 3–5	Grade 2	-1.628	200 - 728	729 - 891	892 - 2000
Math Grades 3–5	Grade 3	-0.883	200 - 821	822 - 984	985 - 2000
Math Grades 3–5	Grade 4	-0.180	200 - 909	910 - 1072	1073 - 2000
Math Grades 3–5	Grade 5	0.208	200 - 957	958 - 1120	1121 - 2000
Math Gr 6–HS	Grade 6	0.726	200 - 1022	1023 - 1185	1186 - 2000
Math Gr 6–HS	Grade 7	1.195	200 - 1081	1082 - 1244	1245 - 2000
Math Gr 6–HS	Grade 8	1.513	200 - 1120	1121 - 1283	1284 - 2000
Math Gr 6–HS	High School	1.613	400 - 1133	1134 - 1296	1297 - 2000
Algebra I	Algebra I	1.613	400 - 1133	1134 - 1296	1297 - 2000
Geometry	Geometry	1.864	400 - 1164	1165 - 1327	1328 - 2000
Algebra II	Algebra II	2.367	400 - 1227	1228 - 1390	1391 - 2000
Reading Grades 3–5	Grade 2	-0.936	200 - 630	631 - 845	846 - 2000
Reading Grades 3–5	Grade 3	-0.167	200 - 740	741 - 955	956 - 2000
Reading Grades 3–5	Grade 4	0.429	200 - 825	826 - 1040	1041 - 2000
Reading Grades 3–5	Grade 5	0.879	200 - 889	890 - 1104	1105 - 2000
Read/Lit Grades 6–HS	Grade 6	1.265	200 - 944	945 - 1159	1160 - 2000
Read/Lit Grades 6–HS	Grade 7	1.499	200 - 978	979 - 1193	1194 - 2000
Read/Lit Grades 6–HS	Grade 8	1.725	200 - 1010	1011 - 1225	1226 - 2000
Read/Lit Grades 6–HS	Literature	1.882	200 - 1032	1033 - 1247	1248 - 2000
Science Grades 3–5	Grade 2	-1.723	200 - 634	635 - 807	808 - 2000
Science Grades 3–5	Grade 3	-1.282	200 - 693	694 - 866	867 - 2000
Science Grades 3–5	Grade 4	-0.855	200 - 750	751 - 923	924 - 2000
Science Grades 3–5	Grade 5	-0.451	200 - 803	804 - 976	977 - 2000
Science Gr 6–HS	Grade 6	-0.028	200 - 860	861 - 1033	1034 - 2000
Science Gr 6–HS	Grade 7	0.329	200 - 907	908 - 1080	1081 - 2000
Science Gr 6–HS	Grade 8	0.639	200 - 948	949 - 1121	1122 - 2000
Science Gr 6–HS	High School	1.112	400 - 1011	1012 - 1184	1185 - 2000
Biology	Biology	1.112	400 - 1011	1012 - 1184	1185 - 2000
Chemistry	Chemistry	1.356	400 - 1044	1045 - 1217	1218 - 2000
Writing Grades 3–5	Grade 2	-1.739	200 - 631	632 - 804	805 - 2000
Writing Grades 3–5	Grade 3	-0.624	200 - 779	780 - 952	953 - 2000
Writing Grades 3–5	Grade 4	-0.084	200 - 851	852 - 1024	1025 - 2000
Writing Grades 3–5	Grade 5	0.281	200 - 899	900 - 1072	1073 - 2000
Writing/Eng Comp Gr 6–HS	Grade 6	0.563	200 - 937	938 - 1110	1111 - 2000

Table 19–3 (continued). Benchmark Cuts and Scale Score Ranges for the 2021–2022 School Year

CDT	Course/Grade	Logit Cut Point (Center of Green)	Red Scale Score Range	Green Scale Score Range	Blue Scale Score Range
Writing/Eng Comp Gr 6–HS	Grade 7	0.836	200 - 973	974 - 1146	1147 - 2000
Writing/Eng Comp Gr 6–HS	Grade 8	0.919	200 - 984	985 - 1157	1158 - 2000
Writing/Eng Comp Gr 6–HS	English Composition	0.981	200 - 993	994 - 1166	1167 - 2000

APPENDIX A: GENERAL DEVELOPMENT AND FIELD TEST CYCLE FOR THE CLASSROOM DIAGNOSTIC TOOLS

Table A–1. General Development and Field Test Cycle for the Classroom Diagnostic Tools

	Mathematics	Reading/Literature	Science	Writing/English Composition
Summer/Fall 2009	Item Development and Internal Reviews			
Winter 2009/2010	Item Review by Pennsylvania Educators	Item Development and Internal Reviews	Item Development and Internal Reviews	
Spring 2010	Stand-alone Field Test	Item Development and Internal Reviews	Item Development and Internal Reviews	
Summer 2010	Data Review, Items Aligned to the Learning Progression Map, and Benchmarking	Item Review by Pennsylvania Educators	Item Review by Pennsylvania Educators	Item Development and Internal Reviews
Fall 2010	Operational Assessments Available	Stand-alone Field Test	Stand-alone Field Test	Item Development and Internal Reviews
Winter 2010/2011	Operational Assessments Available	Data Review, Items Aligned to the Learning Progression Map, and Benchmarking	Data Review, Items Aligned to the Learning Progression Map, and Benchmarking	Item Review by Pennsylvania Educators
Spring 2011	Operational Assessments Available	Operational Assessments Available	Operational Assessments Available	Stand-alone Field Test
Summer 2011				Data Review, Items Aligned to the Learning Progression Map, and Benchmarking
Fall 2011	Operational Assessments Available	Operational Assessments Available	Operational Assessments Available	Operational Assessments Available
Winter 2011/2012	Operational Assessments Available	Operational Assessments Available	Operational Assessments Available	Operational Assessments Available
Spring 2012	Operational Assessments Available	Operational Assessments Available	Operational Assessments Available	Operational Assessments Available
Summer 2012	Item Development and Internal Reviews of Items Aligned to Pennsylvania Core Standards Begins	Item Development and Internal Reviews of Items Aligned to Pennsylvania Core Standards Begins		
Fall 2012	Operational Assessments Available and Completion of Item Development and Internal Reviews of Items Aligned to Pennsylvania Core Standards	Operational Assessments Available and Completion of Item Development and Internal Reviews of Items Aligned to Pennsylvania Core Standards	Operational Assessments Available	Operational Assessments Available

Table A–1 (continued). General Development and Field Test Cycle for the Classroom Diagnostic Tools

	Mathematics	Reading/Literature	Science	Writing/English Composition
Winter 2012/2013	Operational Assessments Available and Item Review by Pennsylvania Educators for Items Aligned to Pennsylvania Core Standards	Operational Assessments Available and Item Review by Pennsylvania Educators for Items Aligned to Pennsylvania Core Standards	Operational Assessments Available	Operational Assessments Available
Spring 2013	Operational Assessments with Embedded Field Test Items Aligned to the Pennsylvania Core Standards Available and Item Development and Internal Reviews of Items for Lower Grades CDT	Operational Assessments with Embedded Field Test Items Aligned to the Pennsylvania Core Standards Available and Item Development and Internal Reviews of Items Lower Grades CDT	Operational Assessments Available and Item Development and Internal Reviews of Items for Lower Grades CDT	Operational Assessments Available and Item Development and Internal Reviews of Items for Lower Grades CDT
Summer 2013	Data Review and Items Aligned to the Learning Progression Map for Items Aligned to the Pennsylvania Core Standards and Item Review by Pennsylvania Educators for Items for Lower Grades	Data Review and Items Aligned to the Learning Progression Map for Items Aligned to the Pennsylvania Core Standards and Item Review by Pennsylvania Educators for Items for Lower Grades	Item Review by Pennsylvania Educators for Items for Lower Grades	Item Review by Pennsylvania Educators for Items for Lower Grades
Fall 2013	Operational Assessments Aligned to PCS Including Embedded Field Test Items at Grade 6 Available and Stand-alone Field Test for Lower Grades	Operational Assessments Aligned to PCS Including Embedded Field Test Items at Grade 6 Available and Stand-alone Field Test for Lower Grades	Operational Assessments Aligned to PCS Including Embedded Field Test Items at Grade 6 Available and Stand-alone Field Test for Lower Grades	Operational Assessments Aligned to PCS Including Embedded Field Test Items at Grade 6 Available and Stand-alone Field Test for Lower Grades
Winter 2013/2014	Operational Assessments Aligned to PCS Available and Data Review and Items Aligned to the Learning Progression Map for Items for Lower Grades CDT	Operational Assessments Aligned to PCS Available and Data Review and Items Aligned to the Learning Progression Map for Items for Lower Grades CDT	Operational Assessments Aligned to PCS Available and Data Review and Items Aligned to the Learning Progression Map for Items for Lower Grades CDT	Operational Assessments Aligned to PCS Available and Data Review and Items Aligned to the Learning Progression Map for Items for Lower Grades CDT
Spring 2014	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available
Winter 2014/2015	Item Development and Internal Reviews of Replenishment Items for Grades 6–HS CDT	Item Development and Internal Reviews of Replenishment Items for Grades 6–HS and EBSR items for all grade levels CDT	Item Development and Internal Reviews of Replenishment Items for Grades 6–HS CDT	Item Development and Internal Reviews of Replenishment Items for Grades 6–HS CDT
Spring 2015	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available

Table A–1 (continued). General Development and Field Test Cycle for the Classroom Diagnostic Tools

	Mathematics	Reading/Literature	Science	Writing/English Composition
Spring 2016	Data Review of Items Aligned to the Learning Progression Map for Items Aligned to the Pennsylvania Core Standards and Item Review by Pennsylvania Educators and Operational Assessments, including Lower Grades, Available	Data Review of Items Aligned to the Learning Progression Map for Items Aligned to the Pennsylvania Core Standards and Item Review by Pennsylvania Educators and Operational Assessments, including Lower Grades, Available	Data Review of Items Aligned to the Learning Progression Map for Items Aligned to the Pennsylvania Core Standards and Item Review by Pennsylvania Educators and Operational Assessments, including Lower Grades, Available	Data Review of Items Aligned to the Learning Progression Map for Items Aligned to the Pennsylvania Core Standards and Item Review by Pennsylvania Educators and Operational Assessments, including Lower Grades, Available
Spring 2017	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available
Winter 2017/2018	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.
Fall 2018	Operational Assessments Aligned to PCS Including Embedded Field Test Items	Operational Assessments Aligned to PCS Including Embedded Field Test Items	Operational Assessments Aligned to PCS Including Embedded Field Test Items. Item Development and Internal Reviews of Technology Enhanced Items.	Operational Assessments Aligned to PCS Including Embedded Field Test Items
Spring 2019	Data Review by Pennsylvania Educators.	Data Review by Pennsylvania Educators.	Data Review by Pennsylvania Educators.	Data Review by Pennsylvania Educators.
Summer 2019	Operational Assessments of full CDT assessments and Diagnostic Category Assessments Aligned to PCS	Operational Assessments of full CDT assessments and Diagnostic Category Assessments Aligned to PCS	Operational Assessments of full CDT assessments and Diagnostic Category Assessments Aligned to PCS	Operational Assessments of full CDT assessments and Diagnostic Category Assessments Aligned to PCS
Spring 2020			Data Review of Technology Enhanced Items by Pennsylvania Educators.	
Summer 2020			Operational Assessments of full CDT assessments and Diagnostic Category Assessments Aligned to PCS	
Spring 2022	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.
Summer 2022	Embedded Field Test Items	Embedded Field Test Items	Embedded Field Test Items	Embedded Field Test Items

APPENDIX B: FIELD TEST ITEM STATISTICS

There were no items field tested during the 2021-2022 school year. Location of classical item statistics for previously field tested items are detailed below.

MATHEMATICS MULTIPLE-CHOICE ITEMS

There were no multiple-choice items in the mathematics content area field tested during the 2021–2022 school year. Classical item statistics for all items field tested prior to 2018–2019 can be found in Appendix B of the 2017–2018 technical report. Classical item statistics for items field tested in 2018–19 can be found in Appendix B of the 2018–2019 technical report.

READING/LITERATURE MULTIPLE-CHOICE ITEMS

There were no multiple-choice items in the reading content area field tested during the 2021–2022 school year. Classical item statistics for all items field tested prior to 2018–2019 can be found in Appendix B of the 2017–2018 technical report. Classical item statistics for items field tested in 2018–19 can be found in Appendix B of the 2018–2019 technical report.

SCIENCE MULTIPLE-CHOICE ITEMS

There were no multiple-choice items in the science content area field tested during the 2021–2022 school year. Classical item statistics for all items field tested prior to 2018–2019 can be found in Appendix B of the 2017–2018 technical report. Classical item statistics for items field tested in 2018–2019 can be found in Appendix B of the 2018–2019 technical report.

WRITING/ENGLISH COMPOSITION MULTIPLE-CHOICE ITEMS

There were no multiple-choice items in the writing content area field tested during the 2021–2022 school year. Classical item statistics for all items field tested prior to 2018–2019 can be found in Appendix B of the 2017–2018 technical report. Classical item statistics for items field tested in 2018–2019 can be found in Appendix B of the 2018–2019 technical report.

READING/LITERATURE EVIDENCE-BASED SELECTED-RESPONSE ITEMS

There were no evidence-based selected-response items in the reading content area field tested during the 2021–2022 school year. Classical item statistics for all items field tested prior to 2018–2019 can be found in Appendix B of the 2017–2018 technical report. Classical item statistics for items field tested in 2018–2019 can be found in Appendix B of the 2018–2019 technical report.

SCIENCE TECHNOLOGY-ENHANCED ITEMS

There were no technology-enhanced items in the science content area field tested during the 2021–2022 school year. Classical item statistics for items field tested in 2019–2020 can be found in Appendix B of the 2019–2020 technical report.

APPENDIX C: VERTICAL LINKING ITEM DETAILS

This appendix provides details on the items used to build the vertical scales in each content area. Information such as grade, n-count, eligible content code, and diagnostic category is provided for each of the vertical linking items. This information is based on the academic standards in place at the time each of the content area vertical scale was established[1]. Summary tables indicate the number of linking items in each diagnostic category. A sample of the vertical linking Excel file is provided as well as plots of the vertical linking items.

MATHEMATICS

Tables C–1 through C–8 show n-counts, eligible content code, and diagnostic category for each of the vertical linking items.

Each item was administered in two grades so there are two n-counts: one for the lower grade and one for the upper grade. For example, item 600869 is a grade 3 item used to link grades 3 and 4. It was administered 1,280 times on the lower grade forms (grade 3) and 964 times on the upper grade forms (grade 4).

Diagnostic categories for Algebra I, Geometry, and Algebra II are different than diagnostic categories for grades 3 through 8 and 11 Mathematics. Items may fall into both a Mathematics diagnostic category and an Algebra I, Geometry, or Algebra II diagnostic category. This is shown in Tables C–6, C–7, and C–8. For example, item 601329 is in the Mathematics diagnostic category “Geometry” and the Geometry diagnostic category “Coordinate Geometry and Right Triangles”.

The Mathematics diagnostic categories are[2]:

- Numbers and Operations
- Measurement
- Geometry
- Algebraic Concepts
- Data Analysis and Probability

The Algebra I diagnostic categories are:

- Operations with Real Numbers and Expressions
- Linear Equations & Inequalities
- Functions & Coordinate Geometry
- Data Analysis

The Geometry diagnostic categories are:

- Geometric Properties
- Congruence, Similarity, & Proofs
- Coordinate Geometry and Right Triangles
- Measurement

The Algebra II diagnostic categories are:

- Operations with Complex Numbers
- Non-linear Expressions & Equations
- Functions
- Data Analysis

[1] Before the 2013–2014 school year items in mathematics, reading, and writing were re-aligned to the new Pennsylvania Core Standards.
[2] Mathematics diagnostic categories changed at the start of the 2013–2014 school year due to re-alignment to the Pennsylvania Core Standards. See Chapter Thirteen for a list of the current diagnostic categories.

Table C–1. Mathematics Items Used to Link Grade 3 to Grade 4

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
600869	3	Grade 3 to Grade 4	1280	964	M3.B.1.1.1	Measure.
600871	3	Grade 3 to Grade 4	1275	964	M3.B.2.2.1	Measure.
601980	3	Grade 3 to Grade 4	1280	964	M3.B.1.2.1	Measure.
604352	3	Grade 3 to Grade 4	1281	964	M3.D.2.1.1	Alg. Con.
600442	3	Grade 3 to Grade 4	1280	964	M3.C.2.1.1	Geo.
600431	3	Grade 3 to Grade 4	1274	964	M3.A.1.1.1	Numbers & Op.
601975	3	Grade 3 to Grade 4	1281	964	M3.A.2.1.1	Numbers & Op.
600865	3	Grade 3 to Grade 4	1279	964	M3.A.1.3.1	Numbers & Op.
601985	3	Grade 3 to Grade 4	1285	963	M3.E.1.1.1	Data & Prob.
601897	3	Grade 3 to Grade 4	1282	964	M3.A.1.2.1	Numbers & Op.
601437	3	Grade 3 to Grade 4	1274	963	M3.A.1.1.4	Numbers & Op.
600438	3	Grade 3 to Grade 4	1277	963	M3.A.1.2.2	Numbers & Op.
600427	3	Grade 3 to Grade 4	1282	963	M3.C.1.1.1	Geo.
600877	3	Grade 3 to Grade 4	1283	963	M3.E.1.2.1	Data & Prob.
601587	3	Grade 3 to Grade 4	1276	963	M3.A.2.1.3	Numbers & Op.
600440	3	Grade 3 to Grade 4	639	963	M3.B.2.1.1	Measure.
600921	3	Grade 3 to Grade 4	1271	963	M3.A.1.3.2	Numbers & Op.
601589	3	Grade 3 to Grade 4	639	962	M3.D.1.1.1	Alg. Con.
601440	3	Grade 3 to Grade 4	1272	962	M3.B.1.1.3	Measure.
601984	3	Grade 3 to Grade 4	1278	962	M3.D.2.1.2	Alg. Con.
604193	4	Grade 3 to Grade 4	1283	959	M4.D.1.1.2	Alg. Con.
602015	4	Grade 3 to Grade 4	1284	481	M4.E.1.2.1	Data & Prob.
601993	4	Grade 3 to Grade 4	1282	1447	M4.C.1.1.1	Geo.
603609	4	Grade 3 to Grade 4	1284	959	M4.B.2.1.1	Measure.
604189	4	Grade 3 to Grade 4	1280	962	M4.B.1.1.3	Measure.
602010	4	Grade 3 to Grade 4	1285	961	M4.C.1.1.2	Geo.
601646	4	Grade 3 to Grade 4	1283	960	M4.D.2.2.2	Alg. Con.
604186	4	Grade 3 to Grade 4	1279	965	M4.A.3.1.1	Numbers & Op.
601958	4	Grade 3 to Grade 4	1281	961	M4.A.1.1.2	Numbers & Op.
604488	4	Grade 3 to Grade 4	1279	958	M4.A.1.2.2	Numbers & Op.
603744	4	Grade 3 to Grade 4	1279	481	M4.B.2.2.1	Measure.
602009	4	Grade 3 to Grade 4	1279	963	M4.C.1.1.2	Geo.
604514	4	Grade 3 to Grade 4	1280	481	M4.C.2.1.1	Geo.
604492	4	Grade 3 to Grade 4	1278	961	M4.A.3.1.2	Numbers & Op.
601972	4	Grade 3 to Grade 4	1281	965	M4.E.1.2.2	Data & Prob.
601962	4	Grade 3 to Grade 4	1278	962	M4.A.1.3.2	Numbers & Op.
601987	4	Grade 3 to Grade 4	1278	961	M4.A.1.1.4	Numbers & Op.

Table C–1 (continued). Mathematics Items Used to Link Grade 3 to Grade 4

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
604195	4	Grade 3 to Grade 4	1279	481	M4.D.2.1.1	Alg. Con.
604501	4	Grade 3 to Grade 4	1279	959	M4.E.1.1.1	Data & Prob.
604493	4	Grade 3 to Grade 4	1279	1443	M4.B.1.1.4	Measure.

Table C–2. Mathematics Items Used to Link Grade 4 to Grade 5

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
601646	4	Grade 4 to Grade 5	960	1187	M4.D.2.2.2	Alg. Con.
601987	4	Grade 4 to Grade 5	961	1186	M4.A.1.1.4	Numbers & Op.
604493	4	Grade 4 to Grade 5	1443	1183	M4.B.1.1.4	Measure.
601961	4	Grade 4 to Grade 5	965	1184	M4.A.1.3.2	Numbers & Op.
604499	4	Grade 4 to Grade 5	962	1188	M4.E.1.1.1	Data & Prob.
602889	4	Grade 4 to Grade 5	962	1187	M4.E.1.2.2	Data & Prob.
602885	4	Grade 4 to Grade 5	965	1186	M4.B.2.2.1	Measure.
602887	4	Grade 4 to Grade 5	962	1187	M4.C.3.1.1	Geo.
601639	4	Grade 4 to Grade 5	960	1184	M4.A.3.1.3	Numbers & Op.
604969	4	Grade 4 to Grade 5	480	1184	M4.C.1.2.2	Geo.
601994	4	Grade 4 to Grade 5	479	1185	M4.D.1.2.2	Alg. Con.
601998	4	Grade 4 to Grade 5	960	1191	M4.E.3.1.1	Data & Prob.
602000	4	Grade 4 to Grade 5	959	1190	M4.C.1.1.1	Geo.
601991	4	Grade 4 to Grade 5	959	1189	M4.A.2.1.2	Numbers & Op.
604879	4	Grade 4 to Grade 5	1441	1188	M4.D.1.1.3	Alg. Con.
601964	4	Grade 4 to Grade 5	961	1188	M4.A.3.2.2	Numbers & Op.
602971	4	Grade 4 to Grade 5	480	1187	M4.B.2.1.1	Measure.
604486	4	Grade 4 to Grade 5	481	1186	M4.E.1.2.1	Data & Prob.
604967	4	Grade 4 to Grade 5	962	1187	M4.A.1.2.2	Numbers & Op.
602973	4	Grade 4 to Grade 5	964	1186	M4.C.2.1.1	Geo.
600853	5	Grade 4 to Grade 5	964	1790	M5.B.2.1.1	Measure.
604790	5	Grade 4 to Grade 5	964	586	M5.C.2.1.2	Geo.
604956	5	Grade 4 to Grade 5	959	1175	M5.A.2.1.1	Numbers & Op.
604862	5	Grade 4 to Grade 5	960	1182	M5.D.1.2.1	Alg. Con.
604783	5	Grade 4 to Grade 5	961	1179	M5.A.1.2.1	Numbers & Op.
606159	5	Grade 4 to Grade 5	960	1190	M5.A.1.5.1	Numbers & Op.
604848	5	Grade 4 to Grade 5	961	1784	M5.E.3.1.1	Data & Prob.
604843	5	Grade 4 to Grade 5	959	1186	M5.C.1.1.2	Geo.
604966	5	Grade 4 to Grade 5	961	596	M5.E.1.1.1	Data & Prob.
606163	5	Grade 4 to Grade 5	961	1188	M5.B.1.1.1	Measure.
601532	5	Grade 4 to Grade 5	956	2369	M5.A.1.1.1	Numbers & Op.
606160	5	Grade 4 to Grade 5	958	1190	M5.A.3.1.1	Numbers & Op.
604960	5	Grade 4 to Grade 5	957	594	M5.B.2.2.3	Measure.
600852	5	Grade 4 to Grade 5	958	1178	M5.D.1.1.1	Alg. Con.
604834	5	Grade 4 to Grade 5	954	1189	M5.A.1.3.1	Numbers & Op.
604959	5	Grade 4 to Grade 5	956	1183	M5.B.1.2.2	Measure.
604961	5	Grade 4 to Grade 5	956	1193	M5.C.1.2.1	Geo.

Table C–2 (continued). Mathematics Items Used to Link Grade 4 to Grade 5

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
606278	5	Grade 4 to Grade 5	954	1177	M5.D.2.1.2	Alg. Con.
604965	5	Grade 4 to Grade 5	957	1190	M5.E.1.1.1	Data & Prob.
604865	5	Grade 4 to Grade 5	956	1192	M5.A.1.6.2	Numbers & Op.

Table C–3. Mathematics Items Used to Link Grade 5 to Grade 6

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
606277	5	Grade 5 to Grade 6	1175	1225	M5.D.2.1.2	Alg. Con.
606153	5	Grade 5 to Grade 6	590	1225	M5.A.1.4.2	Numbers & Op.
604796	5	Grade 5 to Grade 6	1194	1224	M5.B.1.3.2	Measure.
606154	5	Grade 5 to Grade 6	1195	1223	M5.A.2.1.3	Numbers & Op.
604962	5	Grade 5 to Grade 6	1192	1222	M5.C.1.2.1	Geo.
606826	5	Grade 5 to Grade 6	593	1221	M5.A.1.3.2	Numbers & Op.
604859	5	Grade 5 to Grade 6	1766	1223	M5.C.1.1.1	Geo.
604860	5	Grade 5 to Grade 6	1184	1215	M5.D.1.2.1	Alg. Con.
606167	5	Grade 5 to Grade 6	1181	1216	M5.E.3.1.1	Data & Prob.
604836	5	Grade 5 to Grade 6	1176	1216	M5.A.1.6.1	Numbers & Op.
606162	5	Grade 5 to Grade 6	593	1216	M5.B.1.1.1	Measure.
604841	5	Grade 5 to Grade 6	594	1215	M5.B.2.2.1	Measure.
606155	5	Grade 5 to Grade 6	1193	1215	M5.C.2.1.2	Geo.
601592	5	Grade 5 to Grade 6	595	1214	M5.E.2.1.1	Data & Prob.
601590	5	Grade 5 to Grade 6	2372	1214	M5.A.1.1.1	Numbers & Op.
604953	5	Grade 5 to Grade 6	1171	1226	M5.A.1.3.3	Numbers & Op.
604853	5	Grade 5 to Grade 6	1175	1227	M5.A.1.5.1	Numbers & Op.
604784	5	Grade 5 to Grade 6	1178	1227	M5.A.1.2.1	Numbers & Op.
604868	5	Grade 5 to Grade 6	1176	1225	M5.B.1.2.1	Measure.
604964	5	Grade 5 to Grade 6	1190	1226	M5.E.1.1.1	Data & Prob.
601542	5	Grade 5 to Grade 6	1189	1225	M5.B.2.1.1	Measure.
606276	5	Grade 5 to Grade 6	590	1223	M5.C.2.1.1	Geo.
604856	5	Grade 5 to Grade 6	1180	1219	M5.A.3.1.1	Numbers & Op.
606166	5	Grade 5 to Grade 6	1181	1220	M5.D.2.1.1	Alg. Con.
604958	5	Grade 5 to Grade 6	1176	1219	M5.A.2.1.1	Numbers & Op.
604842	5	Grade 5 to Grade 6	1182	1219	M5.C.1.1.2	Geo.
606157	5	Grade 5 to Grade 6	1188	1219	M5.D.1.1.2	Alg. Con.
604794	5	Grade 5 to Grade 6	1177	1217	M5.E.2.1.2	Data & Prob.
604869	5	Grade 5 to Grade 6	1191	1216	M5.B.2.2.2	Measure.
606279	5	Grade 5 to Grade 6	1196	1219	M5.E.3.1.2	Data & Prob.
601040	6	Grade 5 to Grade 6	1190	609	M6.E.3.1.1	Data & Prob.
602096	6	Grade 5 to Grade 6	1190	1213	M6.B.2.1.1	Measure.
601730	6	Grade 5 to Grade 6	1191	1223	M6.B.2.2.1	Measure.
602081	6	Grade 5 to Grade 6	1188	1199	M6.E.1.1.3	Data & Prob.
599668	6	Grade 5 to Grade 6	1186	608	M6.A.1.3.1	Numbers & Op.
600989	6	Grade 5 to Grade 6	1184	1223	M6.D.1.1.1	Alg. Con.
602070	6	Grade 5 to Grade 6	1184	614	M6.E.1.1.1	Data & Prob.

Table C–3 (continued). Mathematics Items Used to Link Grade 5 to Grade 6

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
601689	6	Grade 5 to Grade 6	1185	609	M6.C.1.2.2	Geo.
601031	6	Grade 5 to Grade 6	1185	1206	M6.D.2.1.2	Alg. Con.
602174	6	Grade 5 to Grade 6	1181	1210	M6.A.3.2.1	Numbers & Op.
601249	6	Grade 5 to Grade 6	1186	600	M6.C.3.1.1	Geo.
599670	6	Grade 5 to Grade 6	1181	1199	M6.A.1.3.2	Numbers & Op.
600978	6	Grade 5 to Grade 6	1184	615	M6.D.2.2.1	Alg. Con.
601706	6	Grade 5 to Grade 6	1186	1209	M6.E.2.1.1	Data & Prob.
601024	6	Grade 5 to Grade 6	1183	608	M6.D.1.2.1	Alg. Con.
602176	6	Grade 5 to Grade 6	1183	1213	M6.B.1.1.1	Measure.
602071	6	Grade 5 to Grade 6	1184	1210	M6.E.1.1.2	Data & Prob.
602104	6	Grade 5 to Grade 6	1179	607	M6.B.2.1.2	Measure.
599667	6	Grade 5 to Grade 6	1181	1226	M6.A.1.2.1	Numbers & Op.
601260	6	Grade 5 to Grade 6	1181	610	M6.C.1.1.1	Geo.

Table C–4. Mathematics Items Used to Link Grade 6 to Grade 7

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
599606	6	Grade 6 to Grade 7	1224	792	M6.A.1.2.1	Numbers & Op.
601257	6	Grade 6 to Grade 7	1214	792	M6.C.3.1.1	Geo.
601026	6	Grade 6 to Grade 7	614	790	M6.D.1.2.1	Alg. Con.
601705	6	Grade 6 to Grade 7	1221	786	M6.E.1.1.1	Data & Prob.
601811	6	Grade 6 to Grade 7	1220	785	M6.A.2.1.1	Numbers & Op.
601714	6	Grade 6 to Grade 7	1203	786	M6.C.1.2.1	Geo.
601032	6	Grade 6 to Grade 7	1210	783	M6.D.2.1.2	Alg. Con.
599590	6	Grade 6 to Grade 7	2447	783	M6.A.1.1.1	Numbers & Op.
602095	6	Grade 6 to Grade 7	606	784	M6.B.2.1.3	Measure.
601700	6	Grade 6 to Grade 7	1230	785	M6.C.1.1.3	Geo.
601277	6	Grade 6 to Grade 7	1223	785	M6.E.3.1.1	Data & Prob.
602073	6	Grade 6 to Grade 7	603	784	M6.E.1.1.3	Data & Prob.
599643	6	Grade 6 to Grade 7	1217	778	M6.A.1.3.2	Numbers & Op.
602177	6	Grade 6 to Grade 7	1217	778	M6.B.1.1.1	Measure.
601220	6	Grade 6 to Grade 7	1205	778	M6.B.2.3.1	Measure.
601030	6	Grade 6 to Grade 7	1217	789	M6.D.2.1.1	Alg. Con.
601275	6	Grade 6 to Grade 7	592	786	M6.E.2.1.1	Data & Prob.
601678	6	Grade 6 to Grade 7	1220	785	M6.D.1.1.1	Alg. Con.
601301	6	Grade 6 to Grade 7	1220	785	M6.E.1.1.2	Data & Prob.
601245	6	Grade 6 to Grade 7	1225	783	M6.E.3.1.2	Data & Prob.
599593	6	Grade 6 to Grade 7	1221	784	M6.A.1.1.2	Numbers & Op.
601664	6	Grade 6 to Grade 7	600	780	M6.C.1.1.4	Geo.
599609	6	Grade 6 to Grade 7	1207	776	M6.A.1.3.1	Numbers & Op.
601799	6	Grade 6 to Grade 7	1211	778	M6.A.1.4.1	Numbers & Op.
602101	6	Grade 6 to Grade 7	612	775	M6.B.2.1.1	Measure.
602175	6	Grade 6 to Grade 7	614	773	M6.A.3.2.1	Numbers & Op.
601044	6	Grade 6 to Grade 7	1210	773	M6.D.2.2.1	Alg. Con.
601694	6	Grade 6 to Grade 7	1211	773	M6.C.1.1.2	Geo.
602088	6	Grade 6 to Grade 7	1226	772	M6.B.2.2.1	Measure.
601702	6	Grade 6 to Grade 7	605	771	M6.C.1.2.2	Geo.
601287	7	Grade 6 to Grade 7	1222	395	M7.D.2.1.1	Alg. Con.
601050	7	Grade 6 to Grade 7	1223	399	M7.E.2.1.1	Data & Prob.
601772	7	Grade 6 to Grade 7	1222	793	M7.D.1.1.1	Alg. Con.
602215	7	Grade 6 to Grade 7	1222	765	M7.B.2.1.3	Measure.
601132	7	Grade 6 to Grade 7	1221	764	M7.E.4.1.1	Data & Prob.
599720	7	Grade 6 to Grade 7	1221	757	M7.A.2.1.1	Numbers & Op.
602190	7	Grade 6 to Grade 7	1219	788	M7.B.1.1.1	Measure.

Table C–4 (continued). Mathematics Items Used to Link Grade 6 to Grade 7

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
601273	7	Grade 6 to Grade 7	1215	762	M7.D.2.2.1	Alg. Con.
599734	7	Grade 6 to Grade 7	1215	792	M7.A.1.2.1	Numbers & Op.
601784	7	Grade 6 to Grade 7	1216	373	M7.C.1.1.2	Geo.
601278	7	Grade 6 to Grade 7	1213	401	M7.D.3.1.1	Alg. Con.
601704	7	Grade 6 to Grade 7	1214	788	M7.C.3.1.1	Geo.
602189	7	Grade 6 to Grade 7	1212	780	M7.A.3.2.2	Numbers & Op.
601123	7	Grade 6 to Grade 7	1209	385	M7.E.3.1.1	Data & Prob.
599633	7	Grade 6 to Grade 7	1209	797	M7.A.2.2.4	Numbers & Op.
601099	7	Grade 6 to Grade 7	1218	777	M7.E.1.1.1	Data & Prob.
599685	7	Grade 6 to Grade 7	1214	400	M7.A.2.2.2	Numbers & Op.
601124	7	Grade 6 to Grade 7	1216	785	M7.E.3.1.2	Data & Prob.
602193	7	Grade 6 to Grade 7	1214	792	M7.B.2.1.1	Measure.
601827	7	Grade 6 to Grade 7	1211	772	M7.C.1.1.3	Geo.
601067	7	Grade 6 to Grade 7	1208	781	M7.D.2.1.1	Alg. Con.
601379	7	Grade 6 to Grade 7	1212	793	M7.E.2.1.2	Data & Prob.
599708	7	Grade 6 to Grade 7	1206	563	M7.A.1.1.1	Numbers & Op.
601771	7	Grade 6 to Grade 7	1202	767	M7.D.1.1.1	Alg. Con.
601271	7	Grade 6 to Grade 7	1206	761	M7.D.2.2.1	Alg. Con.
599715	7	Grade 6 to Grade 7	1206	781	M7.A.1.2.2	Numbers & Op.
599650	7	Grade 6 to Grade 7	1193	798	M7.A.3.2.1	Numbers & Op.
602180	7	Grade 6 to Grade 7	1199	789	M7.B.1.1.1	Measure.
601355	7	Grade 6 to Grade 7	1190	399	M7.D.3.1.1	Alg. Con.
602202	7	Grade 6 to Grade 7	1194	795	M7.C.1.1.1	Geo.

Table C–5. Mathematics Items Used to Link Grade 8 to Grade 7

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
601054	7	Grade 8 to Grade 7	745	312	M7.E.3.1.1	Data & Prob.
601365	7	Grade 8 to Grade 7	746	312	M7.D.3.1.1	Alg. Con.
601117	7	Grade 8 to Grade 7	747	311	M7.E.1.1.1	Data & Prob.
601835	7	Grade 8 to Grade 7	748	310	M7.C.1.1.3	Geo.
601677	7	Grade 8 to Grade 7	749	312	M7.C.1.2.2	Geo.
602155	7	Grade 8 to Grade 7	750	312	M7.A.3.2.2	Numbers & Op.
602142	7	Grade 8 to Grade 7	751	312	M7.B.2.1.3	Measure.
601300	7	Grade 8 to Grade 7	752	312	M7.D.2.1.2	Alg. Con.
601130	7	Grade 8 to Grade 7	753	312	M7.E.3.1.3	Data & Prob.
599682	7	Grade 8 to Grade 7	754	311	M7.A.2.2.1	Numbers & Op.
602144	7	Grade 8 to Grade 7	755	309	M7.B.2.2.2	Measure.
599732	7	Grade 8 to Grade 7	756	309	M7.A.2.2.6	Numbers & Op.
599727	7	Grade 8 to Grade 7	757	309	M7.A.1.2.1	Numbers & Op.
599686	7	Grade 8 to Grade 7	758	309	M7.A.2.2.3	Numbers & Op.
601687	7	Grade 8 to Grade 7	759	307	M7.C.3.1.2	Geo.
601218	7	Grade 8 to Grade 7	760	315	M7.C.3.1.1	Geo.
599722	7	Grade 8 to Grade 7	761	314	M7.A.2.1.1	Numbers & Op.
599684	7	Grade 8 to Grade 7	762	313	M7.A.2.2.2	Numbers & Op.
602141	7	Grade 8 to Grade 7	763	311	M7.B.2.1.2	Measure.
601051	7	Grade 8 to Grade 7	764	314	M7.E.2.1.2	Data & Prob.
599712	7	Grade 8 to Grade 7	765	314	M7.A.3.2.1	Numbers & Op.
602234	7	Grade 8 to Grade 7	766	314	M7.C.1.1.1	Geo.
602146	7	Grade 8 to Grade 7	767	314	M7.C.1.2.1	Geo.
601773	7	Grade 8 to Grade 7	768	313	M7.D.2.1.1	Alg. Con.
599711	7	Grade 8 to Grade 7	769	313	M7.A.2.2.5	Numbers & Op.
602143	7	Grade 8 to Grade 7	770	313	M7.B.2.2.1	Measure.
601110	7	Grade 8 to Grade 7	771	313	M7.E.3.1.2	Data & Prob.
601272	7	Grade 8 to Grade 7	772	312	M7.D.2.2.1	Alg. Con.
601357	7	Grade 8 to Grade 7	773	313	M7.D.3.1.2	Alg. Con.
601086	7	Grade 8 to Grade 7	774	313	M7.E.4.1.1	Data & Prob.
601263	8	Grade 8 to Grade 7	775	309	M8.C.3.1.1	Geo.
601757	8	Grade 8 to Grade 7	776	158	M8.D.1.1.2	Alg. Con.
601069	8	Grade 8 to Grade 7	777	308	M8.E.4.1.2	Data & Prob.
599651	8	Grade 8 to Grade 7	778	318	M8.A.3.1.2	Numbers & Op.
601073	8	Grade 8 to Grade 7	779	314	M8.D.2.1.3	Alg. Con.
601801	8	Grade 8 to Grade 7	780	154	M8.B.1.1.1	Measure.
599610	8	Grade 8 to Grade 7	781	160	M8.A.2.1.1	Numbers & Op.

Table C–5 (continued). Mathematics Items Used to Link Grade 8 to Grade 7

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
601097	8	Grade 8 to Grade 7	782	159	M8.E.1.1.1	Data & Prob.
601725	8	Grade 8 to Grade 7	783	316	M8.B.1.1.3	Measure.
601744	8	Grade 8 to Grade 7	784	157	M8.B.2.2.3	Measure.
601288	8	Grade 8 to Grade 7	785	157	M8.D.2.1.1	Alg. Con.
601247	8	Grade 8 to Grade 7	786	312	M8.D.2.2.2	Alg. Con.
599698	8	Grade 8 to Grade 7	787	156	M8.A.2.2.2	Numbers & Op.
601763	8	Grade 8 to Grade 7	788	306	M8.D.4.1.2	Alg. Con.
601090	8	Grade 8 to Grade 7	789	154	M8.E.1.1.3	Data & Prob.
601804	8	Grade 8 to Grade 7	790	318	M8.B.1.1.4	Measure.
599640	8	Grade 8 to Grade 7	791	311	M8.A.3.1.1	Numbers & Op.
602158	8	Grade 8 to Grade 7	792	310	M8.B.1.1.2	Measure.
602072	8	Grade 8 to Grade 7	793	315	M8.D.1.1.1	Alg. Con.
601707	8	Grade 8 to Grade 7	794	317	M8.D.1.1.3	Alg. Con.
601332	8	Grade 8 to Grade 7	795	312	M8.D.2.1.2	Alg. Con.
599613	8	Grade 8 to Grade 7	796	317	M8.A.2.2.1	Numbers & Op.
601675	8	Grade 8 to Grade 7	797	317	M8.D.4.1.3	Alg. Con.
601100	8	Grade 8 to Grade 7	798	157	M8.E.3.1.1	Data & Prob.
599583	8	Grade 8 to Grade 7	799	636	M8.A.1.1.1	Numbers & Op.
601340	8	Grade 8 to Grade 7	800	156	M8.D.2.2.1	Alg. Con.
601344	8	Grade 8 to Grade 7	801	321	M8.D.4.1.1	Alg. Con.
600990	8	Grade 8 to Grade 7	802	306	M8.E.1.1.2	Data & Prob.
599645	8	Grade 8 to Grade 7	803	160	M8.A.3.3.1	Numbers & Op.
602058	8	Grade 8 to Grade 7	804	307	M8.C.1.1.1	Geo.

Table C–6. Mathematics Items Used to Link Algebra I to Grade 8

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category	Algebra I Diagnostic Category
601121	8	Algebra I to Grade 8	316	1400	M8.A.3.3.1	Numbers & Op.	Op. with Real Num.
601102	8	Algebra I to Grade 8	310	1406	M8.E.3.1.1	Data & Prob.	Data Anal.
601360	8	Algebra I to Grade 8	155	1403	M8.D.4.1.1	Alg. Con.	Functions & Geo.
601764	8	Algebra I to Grade 8	316	1396	M8.D.4.1.3	Alg. Con.	Functions & Geo.
602052	8	Algebra I to Grade 8	318	1396	M8.D.1.1.3	Alg. Con.	Functions & Geo.
599639	8	Algebra I to Grade 8	154	1391	M8.A.3.1.1	Numbers & Op.	Op. with Real Num.
602065	8	Algebra I to Grade 8	156	1376	M8.D.1.1.1	Alg. Con.	Functions & Geo.
601346	8	Algebra I to Grade 8	306	1390	M8.D.2.2.2	Alg. Con.	Linear Eq.
599582	8	Algebra I to Grade 8	625	1387	M8.A.1.1.1	Numbers & Op.	Op. with Real Num.
599697	8	Algebra I to Grade 8	314	1377	M8.A.2.2.1	Numbers & Op.	Op. with Real Num.
600980	8	Algebra I to Grade 8	318	1376	M8.D.2.1.3	Alg. Con.	Linear Eq.
601127	8	Algebra I to Grade 8	158	1376	M8.E.4.1.1	Data & Prob.	Data Anal.
601776	8	Algebra I to Grade 8	311	1370	M8.D.4.1.2	Alg. Con.	Functions & Geo.
601092	8	Algebra I to Grade 8	306	1362	M8.E.1.1.2	Data & Prob.	Data Anal.
601232	8	Algebra I to Grade 8	151	1359	M8.D.2.1.1	Alg. Con.	Linear Eq.
601348	8	Algebra I to Grade 8	311	1402	M8.D.2.2.1	Alg. Con.	Linear Eq.
601777	8	Algebra I to Grade 8	307	1401	M8.D.4.1.3	Alg. Con.	Functions & Geo.
599619	8	Algebra I to Grade 8	314	1388	M8.A.2.2.2	Numbers & Op.	Op. with Real Num.
601222	8	Algebra I to Grade 8	311	1389	M8.C.3.1.1	Geo.	None
601384	8	Algebra I to Grade 8	317	1388	M8.D.4.1.1	Alg. Con.	Functions & Geo.
601091	8	Algebra I to Grade 8	314	1390	M8.E.1.1.3	Data & Prob.	Data Anal.
599585	8	Algebra I to Grade 8	310	1377	M8.A.2.1.1	Numbers & Op.	Op. with Real Num.
599637	8	Algebra I to Grade 8	308	1380	M8.A.3.1.2	Numbers & Op.	Op. with Real Num.
601231	8	Algebra I to Grade 8	313	1374	M8.D.2.1.1	Alg. Con.	Linear Eq.
601663	8	Algebra I to Grade 8	155	1368	M8.D.1.1.2	Alg. Con.	Functions & Geo.
601126	8	Algebra I to Grade 8	308	1370	M8.E.4.1.2	Data & Prob.	Data Anal.
601089	8	Algebra I to Grade 8	151	1357	M8.E.1.1.2	Data & Prob.	Data Anal.
601234	8	Algebra I to Grade 8	303	1356	M8.D.2.1.2	Alg. Con.	Linear Eq.
601775	8	Algebra I to Grade 8	312	1349	M8.D.4.1.2	Alg. Con.	Functions & Geo.
601103	8	Algebra I to Grade 8	319	1344	M8.E.3.2.1	Data & Prob.	Data Anal.
602259	11	Algebra I to Grade 8	312	714	M11.E.2.1.3	Data & Prob.	Data Anal.
604952	11	Algebra I to Grade 8	312	710	M11.E.4.1.2	Data & Prob.	Data Anal.
601837	A1	Algebra I to Grade 8	312	700	A1.2.2.1.1	Alg. Con.	Functions & Geo.
602184	A1	Algebra I to Grade 8	313	1421	A1.2.1.1.1	Alg. Con.	Functions & Geo.
601554	11	Algebra I to Grade 8	313	711	M11.E.2.1.3	Data & Prob.	Data Anal.
602171	A1	Algebra I to Grade 8	309	1382	A1.2.1.2.2	Alg. Con.	Functions & Geo.
601841	A1	Algebra I to Grade 8	313	1383	A1.2.2.1.2	Alg. Con.	Functions & Geo.

Table C–6 (continued). Mathematics Items Used to Link Algebra I to Grade 8

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category	Algebra I Diagnostic Category
604806	11	Algebra I to Grade 8	312	710	M11.E.4.1.2	Data & Prob.	Data Anal.
600839	11	Algebra I to Grade 8	313	713	M11.E.1.1.1	Data & Prob.	Data Anal.
601461	11	Algebra I to Grade 8	313	711	M11.E.1.1.1	Data & Prob.	Data Anal.
604804	11	Algebra I to Grade 8	313	705	M11.E.2.1.3	Data & Prob.	Data Anal.
602241	A1	Algebra I to Grade 8	312	1420	A1.2.1.2.1	Alg. Con.	Functions & Geo.
601793	A1	Algebra I to Grade 8	313	1425	A1.2.2.1.4	Alg. Con.	Functions & Geo.
602159	A1	Algebra I to Grade 8	312	1416	A1.2.2.2.1	Alg. Con.	Functions & Geo.
602274	11	Algebra I to Grade 8	312	713	M11.E.4.1.2	Data & Prob.	Data Anal.
601135	A1	Algebra I to Grade 8	315	1418	A1.2.3.3.1	Data & Prob.	Data Anal.
601144	A1	Algebra I to Grade 8	317	1415	A1.1.2.1.3	Alg. Con.	Linear Eq.
600842	11	Algebra I to Grade 8	316	717	M11.A.2.1.3	Numbers & Op.	Op. with Real Num.
601370	A1	Algebra I to Grade 8	314	1364	A1.1.3.1.3	Alg. Con.	Linear Eq.
600646	11	Algebra I to Grade 8	315	710	M11.A.3.1.1	Numbers & Op.	Op. with Real Num.
601630	11	Algebra I to Grade 8	314	718	M11.A.3.1.1	Numbers & Op.	Op. with Real Num.
601138	A1	Algebra I to Grade 8	313	1378	A1.2.3.2.1	Data & Prob.	Data Anal.
601139	A1	Algebra I to Grade 8	310	1413	A1.2.3.2.2	Data & Prob.	Data Anal.
600826	11	Algebra I to Grade 8	311	716	M11.A.3.1.1	Numbers & Op.	Op. with Real Num.
601140	A1	Algebra I to Grade 8	310	1408	A1.2.3.2.3	Data & Prob.	Data Anal.
600930	A1	Algebra I to Grade 8	311	707	A1.1.1.4.1	Numbers & Op.	Op. with Real Num.
602260	11	Algebra I to Grade 8	312	717	M11.A.2.1.1	Numbers & Op.	Op. with Real Num.
600931	A1	Algebra I to Grade 8	310	1375	A1.1.1.5.1	Alg. Con.	Op. with Real Num.
602644	11	Algebra I to Grade 8	311	714	M11.A.2.1.1	Numbers & Op.	Op. with Real Num.
604162	11	Algebra I to Grade 8	310	714	M11.A.2.1.2	Numbers & Op.	Op. with Real Num.

Table C–7. Mathematics Items Used to Link Geometry to Grade 8

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category	Geometry Diagnostic Category
601740	8	Geometry to Grade 8	306	1052	M8.B.2.1.3	Measure.	Measure.
602118	8	Geometry to Grade 8	319	1049	M8.B.2.2.1	Measure.	Measure.
602056	8	Geometry to Grade 8	306	1052	M8.C.1.1.2	Geo.	Geo. Prop.
602059	8	Geometry to Grade 8	156	1052	M8.C.1.1.2	Geo.	Geo. Prop.
601733	8	Geometry to Grade 8	151	1039	M8.B.2.1.1	Measure.	Measure.
602133	8	Geometry to Grade 8	320	1049	M8.C.1.1.3	Geo.	Geo. Prop.
602117	8	Geometry to Grade 8	151	1046	M8.B.2.2.2	Measure.	Measure.
602128	8	Geometry to Grade 8	312	1047	M8.C.1.1.1	Geo.	Geo. Prop.
601802	8	Geometry to Grade 8	319	1047	M8.B.1.1.3	Measure.	None
602205	8	Geometry to Grade 8	318	1047	M8.C.1.1.1	Geo.	Geo. Prop.
601723	8	Geometry to Grade 8	306	1037	M8.B.1.1.1	Measure.	None
602208	8	Geometry to Grade 8	317	1043	M8.C.1.1.3	Geo.	Geo. Prop.
601326	8	Geometry to Grade 8	317	1038	M8.C.1.2.1	Geo.	Coor. Geo.
601338	8	Geometry to Grade 8	311	1038	M8.C.3.1.1	Geo.	Coor. Geo.
601371	8	Geometry to Grade 8	316	1031	M8.C.3.1.1	Geo.	Coor. Geo.
601736	8	Geometry to Grade 8	316	1048	M8.B.2.1.2	Measure.	Measure.
602136	8	Geometry to Grade 8	316	1034	M8.C.1.2.1	Geo.	Coor. Geo.
601755	8	Geometry to Grade 8	306	1039	M8.C.1.2.1	Geo.	Coor. Geo.
601372	8	Geometry to Grade 8	316	1037	M8.C.3.1.1	Geo.	Coor. Geo.
601782	8	Geometry to Grade 8	156	1028	M8.B.1.1.4	Measure.	None
602204	8	Geometry to Grade 8	308	1039	M8.C.1.1.1	Geo.	Geo. Prop.
602131	8	Geometry to Grade 8	317	1037	M8.C.1.1.2	Geo.	Geo. Prop.
602061	8	Geometry to Grade 8	314	1035	M8.C.1.1.2	Geo.	Geo. Prop.
602115	8	Geometry to Grade 8	317	1029	M8.B.2.2.2	Measure.	Measure.
602087	8	Geometry to Grade 8	312	1034	M8.C.1.1.3	Geo.	Geo. Prop.
602212	8	Geometry to Grade 8	319	1030	M8.C.1.1.3	Geo.	Geo. Prop.
601724	8	Geometry to Grade 8	310	1023	M8.B.1.1.2	Measure.	None
602113	8	Geometry to Grade 8	315	1023	M8.B.2.2.1	Measure.	Measure.
601329	8	Geometry to Grade 8	302	1031	M8.C.3.1.1	Geo.	Coor. Geo.
601743	8	Geometry to Grade 8	305	1029	M8.B.2.2.3	Measure.	Measure.
602661	11	Geometry to Grade 8	316	531	M11.B.2.1.1	Measure.	Measure.
604163	11	Geometry to Grade 8	317	531	M11.B.2.2.2	Measure.	Measure.
604671	GE	Geometry to Grade 8	311	1963	G.1.1.1.1	Geo.	Geo. Prop.
604400	GE	Geometry to Grade 8	316	992	G.1.3.1.1	Geo.	Congruence
604389	GE	Geometry to Grade 8	316	1001	G.2.1.1.1	Geo.	Coor. Geo.
604799	11	Geometry to Grade 8	316	528	M11.B.2.3.1	Measure.	Measure.
604418	GE	Geometry to Grade 8	312	478	G.1.2.1.4	Geo.	Geo. Prop.

Table C–7 (continued). Mathematics Items Used to Link Geometry to Grade 8

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category	Geometry Diagnostic Category
600651	11	Geometry to Grade 8	315	531	M11.B.2.2.4	Measure.	Measure.
604707	GE	Geometry to Grade 8	314	1053	G.1.2.1.5	Geo.	Geo. Prop.
604180	11	Geometry to Grade 8	316	528	M11.B.2.2.3	Measure.	Measure.
604378	GE	Geometry to Grade 8	316	1048	G.2.2.1.1	Geo.	Measure.
601544	11	Geometry to Grade 8	316	532	M11.B.2.1.1	Measure.	Measure.
600749	11	Geometry to Grade 8	314	531	M11.B.2.2.4	Measure.	Measure.
604392	GE	Geometry to Grade 8	315	1053	G.1.1.1.4	Geo.	Geo. Prop.
604395	GE	Geometry to Grade 8	314	1024	G.1.3.1.2	Geo.	Congruence
604178	11	Geometry to Grade 8	315	531	M11.C.1.3.1	Geo.	Congruence
600785	11	Geometry to Grade 8	315	530	M11.C.1.2.2	Geo.	Geo. Prop.
604522	11	Geometry to Grade 8	313	533	M11.C.1.4.1	Geo.	Coor. Geo.
604763	GE	Geometry to Grade 8	308	503	G.2.2.2.1	Geo.	Measure.
602650	11	Geometry to Grade 8	313	530	M11.C.1.3.1	Geo.	Congruence
604474	GE	Geometry to Grade 8	313	988	G.2.2.1.2	Geo.	Measure.
604600	GE	Geometry to Grade 8	310	1053	G.2.2.2.4	Geo.	Measure.
604361	GE	Geometry to Grade 8	312	525	G.2.3.2.1	Geo.	Measure.
601550	11	Geometry to Grade 8	311	530	M11.C.1.2.3	Geo.	Geo. Prop.
604360	GE	Geometry to Grade 8	309	1042	G.2.3.1.3	Geo.	Measure.
604170	11	Geometry to Grade 8	309	528	M11.C.1.4.1	Geo.	Coor. Geo.
604354	GE	Geometry to Grade 8	306	1007	G.2.2.3.1	Geo.	Measure.
601549	11	Geometry to Grade 8	306	530	M11.C.1.2.3	Geo.	Geo. Prop.
602268	11	Geometry to Grade 8	305	527	M11.C.1.3.1	Geo.	Congruence
604453	GE	Geometry to Grade 8	304	955	G.2.2.2.2	Geo.	Measure.

Table C–8. Mathematics Items Used to Link Algebra II to Algebra I

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Algebra I Diagnostic Category	Algebra II Diagnostic Category
602167	A1	Algebra II to Algebra I	701	949	A1.1.3.2.1	Linear Eq.	Non-linear
601423	A1	Algebra II to Algebra I	709	951	A1.1.2.1.3	Linear Eq.	Non-linear
602188	A1	Algebra II to Algebra I	708	943	A1.2.2.1.4	Functions & Geo.	Functions
600971	A1	Algebra II to Algebra I	1407	944	A1.1.1.5.1	Op. with Real Num.	Non-linear
601180	A1	Algebra II to Algebra I	1372	948	A1.1.2.1.1	Linear Eq.	Non-linear
601854	A1	Algebra II to Algebra I	670	937	A1.1.2.2.2	Linear Eq.	Non-linear
602253	A1	Algebra II to Algebra I	705	939	A1.2.2.1.2	Functions & Geo.	Functions
601419	A1	Algebra II to Algebra I	693	941	A1.1.3.1.2	Linear Eq.	Non-linear
602251	A1	Algebra II to Algebra I	1371	942	A1.2.1.2.2	Functions & Geo.	Functions
601176	A1	Algebra II to Algebra I	676	941	A1.2.3.2.3	Data Anal.	Data Anal.
600928	A1	Algebra II to Algebra I	1405	935	A1.1.1.2.1	Op. with Real Num.	Non-linear
600926	A1	Algebra II to Algebra I	2816	940	A1.1.1.1.1	Op. with Real Num.	Non-linear
602237	A1	Algebra II to Algebra I	662	931	A1.2.1.1.1	Functions & Geo.	Functions
601394	A1	Algebra II to Algebra I	697	931	A1.2.1.1.3	Functions & Geo.	Functions
600973	A1	Algebra II to Algebra I	682	925	A1.1.1.5.3	Op. with Real Num.	Non-linear
601397	A1	Algebra II to Algebra I	1378	943	A1.1.3.1.1	Linear Eq.	Non-linear
601368	A1	Algebra II to Algebra I	1374	948	A1.1.3.1.3	Linear Eq.	Non-linear
601136	A1	Algebra II to Algebra I	709	942	A1.1.2.1.2	Linear Eq.	Non-linear
601836	A1	Algebra II to Algebra I	713	946	A1.2.2.1.1	Functions & Geo.	Functions
601148	A1	Algebra II to Algebra I	1395	942	A1.2.3.3.1	Data Anal.	Data Anal.
602160	A1	Algebra II to Algebra I	1397	947	A1.2.2.2.1	Functions & Geo.	Functions
601813	A1	Algebra II to Algebra I	1424	941	A1.2.1.2.1	Functions & Geo.	Functions
601805	A1	Algebra II to Algebra I	1348	920	A1.2.2.1.3	Functions & Geo.	Functions
600953	A1	Algebra II to Algebra I	659	940	A1.1.1.1.2	Op. with Real Num.	Non-linear
600932	A1	Algebra II to Algebra I	1411	941	A1.1.1.5.2	Op. with Real Num.	Non-linear
601398	A1	Algebra II to Algebra I	1410	931	A1.1.2.2.1	Linear Eq.	Non-linear
600948	A1	Algebra II to Algebra I	1387	920	A1.2.3.1.1	Data Anal.	Data Anal.
600966	A1	Algebra II to Algebra I	1395	912	A1.1.1.3.1	Op. with Real Num.	Non-linear
602154	A1	Algebra II to Algebra I	1387	918	A1.1.3.2.2	Linear Eq.	Non-linear
601380	A1	Algebra II to Algebra I	1392	915	A1.2.1.1.2	Functions & Geo.	Functions
604700	A2	Algebra II to Algebra I	1406	927	A2.2.1.1.1	Functions & Geo.	Functions
603013	A2	Algebra II to Algebra I	1406	957	A2.1.3.1.4	Linear Eq.	Non-linear
604570	A2	Algebra II to Algebra I	1386	462	A2.2.2.1.3	Functions & Geo.	Functions
603086	A2	Algebra II to Algebra I	1400	914	A2.1.2.1.4	Op. with Real Num.	Non-linear
604625	A2	Algebra II to Algebra I	1380	948	A2.2.1.1.3	Functions & Geo.	Functions
604530	A2	Algebra II to Algebra I	1380	935	A2.1.3.2.2	Linear Eq.	Non-linear
604686	A2	Algebra II to Algebra I	1379	446	A2.2.2.2.1	Functions & Geo.	Functions

Table C–8 (continued). Mathematics Items Used to Link Algebra II to Algebra I

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Algebra I Diagnostic Category	Algebra II Diagnostic Category
603043	A2	Algebra II to Algebra I	1383	932	A2.1.2.1.2	Op. with Real Num.	Non-linear
603037	A2	Algebra II to Algebra I	1366	950	A2.2.1.1.4	Functions & Geo.	Functions
604572	A2	Algebra II to Algebra I	1377	453	A2.2.2.1.4	Functions & Geo.	Functions
603000	A2	Algebra II to Algebra I	1372	471	A2.1.2.2.2	Op. with Real Num.	Non-linear
604537	A2	Algebra II to Algebra I	1373	908	A2.2.1.1.2	Functions & Geo.	Functions
604634	A2	Algebra II to Algebra I	1369	472	A2.2.3.2.3	Data Anal.	Data Anal.
603106	A2	Algebra II to Algebra I	1360	898	A2.2.3.1.2	Data Anal.	Data Anal.
603057	A2	Algebra II to Algebra I	1351	456	A2.2.3.2.1	Data Anal.	Data Anal.
603055	A2	Algebra II to Algebra I	1397	919	A2.2.3.1.1	Data Anal.	Data Anal.
603018	A2	Algebra II to Algebra I	1408	937	A2.1.2.2.1	Op. with Real Num.	Non-linear
604685	A2	Algebra II to Algebra I	1404	476	A2.2.2.2.1	Functions & Geo.	Functions
603126	A2	Algebra II to Algebra I	1396	474	A2.2.3.2.3	Data Anal.	Data Anal.
604539	A2	Algebra II to Algebra I	1395	941	A2.1.3.2.1	Linear Eq.	Non-linear
604540	A2	Algebra II to Algebra I	1382	889	A2.1.3.2.2	Linear Eq.	Non-linear
604703	A2	Algebra II to Algebra I	1397	479	A2.2.1.1.1	Functions & Geo.	Functions
604629	A2	Algebra II to Algebra I	1387	902	A2.2.2.1.1	Functions & Geo.	Functions
603056	A2	Algebra II to Algebra I	1390	928	A2.2.3.2.1	Data Anal.	Data Anal.
603003	A2	Algebra II to Algebra I	1376	473	A2.1.3.1.2	Linear Eq.	Non-linear
604550	A2	Algebra II to Algebra I	1369	939	A2.2.2.1.4	Functions & Geo.	Functions
603098	A2	Algebra II to Algebra I	1374	944	A2.1.2.1.3	Op. with Real Num.	Non-linear
604544	A2	Algebra II to Algebra I	1370	461	A2.2.1.1.2	Functions & Geo.	Functions
604627	A2	Algebra II to Algebra I	1363	953	A2.2.1.1.3	Functions & Geo.	Functions
603042	A2	Algebra II to Algebra I	1368	936	A2.1.2.1.1	Op. with Real Num.	Non-linear

Tables C–9 through C–16 summarize the number of linking items by diagnostic category. Items coded in a Mathematics diagnostic category and an Algebra I, Geometry, or Algebra II diagnostic category are noted.

Table C–9. Number of Items Linking Grade 3 to Grade 4 by Diagnostic Category

Diagnostic Category	Grade 3 Items	Grade 4 Items	Total
Numbers & Operations	8	6	14
Measurement	5	4	9
Geometry	2	4	6
Algebraic Concepts	3	3	6
Data Analysis & Probability	2	3	5
TOTAL	20	20	40

Table C–10. Number of Items Linking Grade 4 to Grade 5 by Diagnostic Category

Diagnostic Category	Grade 4 Items	Grade 5 Items	Total
Numbers & Operations	6	7	13
Measurement	3	4	7
Geometry	4	3	7
Algebraic Concepts	3	3	6
Data Analysis & Probability	4	3	7
TOTAL	20	20	40

Table C–11. Number of Items Linking Grade 5 to Grade 6 by Diagnostic Category

Diagnostic Category	Grade 5 Items	Grade 6 Items	Total
Numbers & Operations	10	4	14
Measurement	6	4	10
Geometry	5	3	8
Algebraic Concepts	4	4	8
Data Analysis & Probability	5	5	10
TOTAL	30	20	50

Table C–12. Number of Items Linking Grade 6 to Grade 7 by Diagnostic Category

Diagnostic Category	Grade 6 Items	Grade 7 Items	Total
Numbers & Operations	8	8	16
Measurement	5	4	9
Geometry	6	4	10
Algebraic Concepts	5	8	13
Data Analysis & Probability	6	6	12
TOTAL	30	30	60

Table C–13. Number of Items Linking Grade 8 to Grade 7 by Diagnostic Category

Diagnostic Category	Grade 7 Items	Grade 8 Items	Total
Numbers & Operations	9	7	16
Measurement	4	5	9
Geometry	6	2	8
Algebraic Concepts	5	11	16
Data Analysis & Probability	6	5	11
TOTAL	30	30	60

Table C–14a. Number of Items Linking Algebra I to Grade 8 by Diagnostic Category

Diagnostic Category	Grade 8 Items	Algebra I Items	Total
Numbers & Operations	7	8	15
Measurement	0	0	0
Geometry	1	0	1
Algebraic Concepts	15	10	25
Data Analysis & Probability	7	12	19
No Grade 8 DC	0	0	0
TOTAL	30	30	60

Table C–14b. Number of Items Linking Algebra I to Grade 8 by Diagnostic Category

Diagnostic Category	Grade 8 Items	Algebra I Items	Total
Operations with Real Numbers	7	9	16
Linear Equations	6	2	8
Functions	9	7	16
Data Analysis	7	12	19
No Algebra I DC	1	0	1
TOTAL	30	30	60

Table C–15a. Number of Items Linking Geometry to Grade 8 by Diagnostic Category

Diagnostic Category	Grade 8 Items	Geometry Items	Total
Numbers & Operations	0	0	0
Measurement	12	0	12
Geometry	18	30	48
Algebraic Concepts	0	0	0
Data Analysis & Probability	0	0	0
No Grade 8 DC	0	0	0
TOTAL	30	30	60

Table C–15b. Number of Items Linking Geometry to Grade 8 by Diagnostic Category

Diagnostic Category	Grade 8 Items	Geometry Items	Total
Geometric Properties	11	8	19
Congruence	0	4	4
Coordinate	7	2	9
Measurement	8	16	24
No Geometry DC	4	0	4
TOTAL	30	30	60

Table C–16a. Number of Items Linking Algebra II to Algebra I by Diagnostic Category

Diagnostic Category	Algebra I Items	Algebra II Items	Total
Operations with Real Numbers	7	6	13
Linear Equations	10	5	15
Functions	10	13	23
Data Analysis	3	6	9
No Algebra I DC	0	0	0
TOTAL	30	30	60

Table C–16b. Number of Items Linking Algebra II to Algebra I by Diagnostic Category

Diagnostic Category	Algebra I Items	Algebra II Items	Total
Op. with Complex Numbers	0	0	0
Non-linear	17	11	28
Functions	10	13	23
Data Analysis	3	6	9
No Algebra II DC	0	0	0
TOTAL	30	30	60

Table C–17. Mathematics Example of Vertical Linking Workbook

		Grade 4 Calibration			Grade 5 Calibration				Grade 4 on		
Item ID	**Item Grade**	**Difficulty**	**Fit**	**Displace**	**Difficulty**	**Fit**	**Displace**	**Discrepancy**	**Grade 5 Scale**	**Robust Z**	**Flag**
601646	4	-1.028	1.020	-0.006	-1.880	1.000	-0.004	-0.852	-1.650	-0.458	
601987	4	0.195	0.970	0.001	-0.384	0.930	0.000	-0.579	-0.427	0.205	
604493	4	0.784	1.030	0.000	0.204	1.010	0.000	-0.580	0.162	0.203	
601961	4	0.684	1.000	0.002	-0.469	0.910	0.000	-1.153	0.062	-1.189	
604499	4	-0.488	0.900	0.001	-0.492	0.910	0.000	-0.004	-1.110	1.601	
602889	4	-0.160	0.920	-0.002	-1.157	0.840	0.000	-0.997	-0.782	-0.810	
602885	4	0.112	1.200	0.003	0.051	1.220	0.000	-0.061	-0.510	1.463	
602887	4	-0.493	1.070	-0.002	-1.063	1.030	0.000	-0.570	-1.115	0.227	
601639	4	0.397	1.070	0.001	0.149	1.090	0.000	-0.248	-0.225	1.009	
604969	4	1.559	1.060	0.000	1.469	1.080	0.000	-0.090	0.937	1.393	
601994	4	0.257	0.950	0.000	0.100	1.090	0.000	-0.157	-0.365	1.230	
601998	4	-0.551	1.120	-0.001	-1.376	1.140	-0.004	-0.825	-1.173	-0.392	
602000	4	2.034	1.070	-0.006	1.248	1.060	-0.003	-0.786	1.412	-0.297	
601991	4	1.106	0.900	0.001	0.095	0.860	-0.003	-1.011	0.484	-0.844	
604879	4	-0.099	1.020	0.000	-1.101	0.870	-0.003	-1.002	-0.721	-0.822	
601964	4	1.069	1.020	0.001	0.154	1.010	-0.003	-0.915	0.447	-0.611	
602971	4	-0.355	1.000	0.000	-0.858	1.070	-0.003	-0.503	-0.977	0.390	
604486	4	-0.420	0.940	0.000	-0.749	0.970	-0.003	-0.329	-1.042	0.812	
604967	4	-1.495	0.900	0.001	-1.254	0.960	-0.003	0.241	-2.117	2.196	high robust Z
602973	4	-0.035	0.940	0.003	0.362	1.220	-0.003	0.397	-0.657	2.575	high robust Z
600853	5	0.883	1.100	0.004	-0.047	1.100	-0.003	-0.930	0.261	-0.647	
604790	5	-0.495	1.010	0.004	-1.082	0.970	0.000	-0.587	-1.117	0.186	
604956	5	1.299	0.870	0.004	0.590	0.820	-0.003	-0.709	0.677	-0.110	
604862	5	1.405	0.920	0.004	0.368	0.850	-0.003	-1.037	0.783	-0.907	
604783	5	0.764	0.970	0.004	-0.814	0.890	0.001	-1.578	0.142	-2.221	high robust Z
606159	5	0.793	1.090	0.004	-0.157	0.990	-0.003	-0.950	0.171	-0.696	
604848	5	0.301	0.910	0.004	-0.707	1.020	0.001	-1.008	-0.321	-0.837	
604843	5	1.481	1.050	0.004	0.819	0.940	0.001	-0.662	0.859	0.004	
604966	5	-1.974	0.920	0.004	-3.190	0.870	-0.005	-1.216	-2.596	-1.342	
606163	5	0.780	1.130	0.004	0.478	1.200	0.002	-0.302	0.158	0.878	
601532	5	-0.368	0.950	0.000	-1.033	0.920	-0.001	-0.665	-0.990	-0.004	
606160	5	0.382	1.070	0.000	-0.313	0.940	-0.005	-0.695	-0.240	-0.076	
604960	5	0.618	0.910	0.000	0.223	1.050	0.000	-0.395	-0.004	0.652	
600852	5	0.753	1.100	0.000	0.050	1.020	0.002	-0.703	0.131	-0.096	
604834	5	-0.673	0.980	0.000	-1.151	0.980	-0.004	-0.478	-1.295	0.450	
604959	5	0.012	0.880	0.000	-0.871	0.840	-0.001	-0.883	-0.610	-0.533	
604961	5	0.141	1.000	0.000	-0.319	1.010	0.002	-0.460	-0.481	0.494	
606278	5	1.197	1.000	0.000	0.700	0.960	0.001	-0.497	0.575	0.404	
604965	5	-1.454	0.890	0.000	-1.565	0.900	-0.005	-0.111	-2.076	1.342	
604865	5	0.454	0.930	0.000	-0.537	0.910	-0.001	-0.991	-0.168	-0.795	
	Mean	0.234			-0.388			-0.622	-0.388	0.101	
	SD	0.887			0.893			0.413	0.887	1.002	
	SD Ratio	0.993									
	Correlation	0.892									
	Add. Constant	-0.622									
	Median							-0.664			
	Q							0.557			

Figures C–1 through C–8 are the adjacent grade linking plots. Items removed from final linking procedure are colored red.

Figure C–1. CDT Mathematics: Grade 3 to Grade 4 Linking – All Links

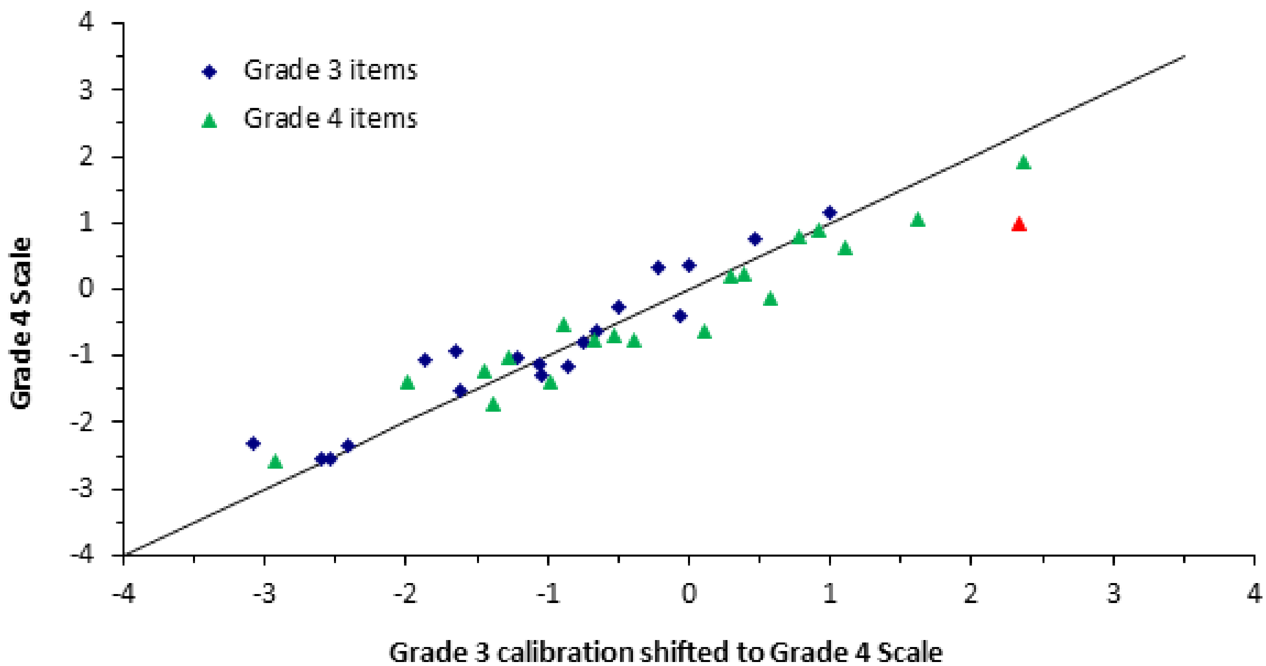


Figure C–2. CDT Mathematics: Grade 4 to Grade 5 Linking – All Links

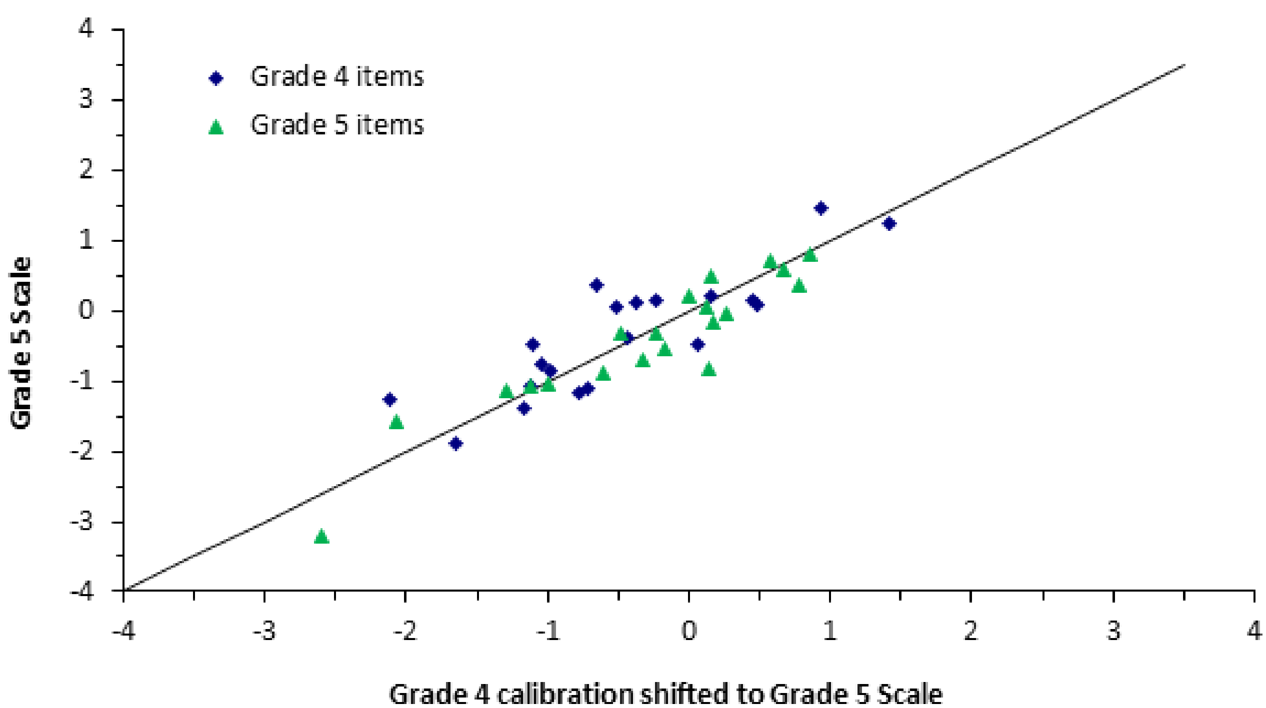


Figure C–3. CDT Mathematics: Grade 5 to Grade 6 Linking – All Links

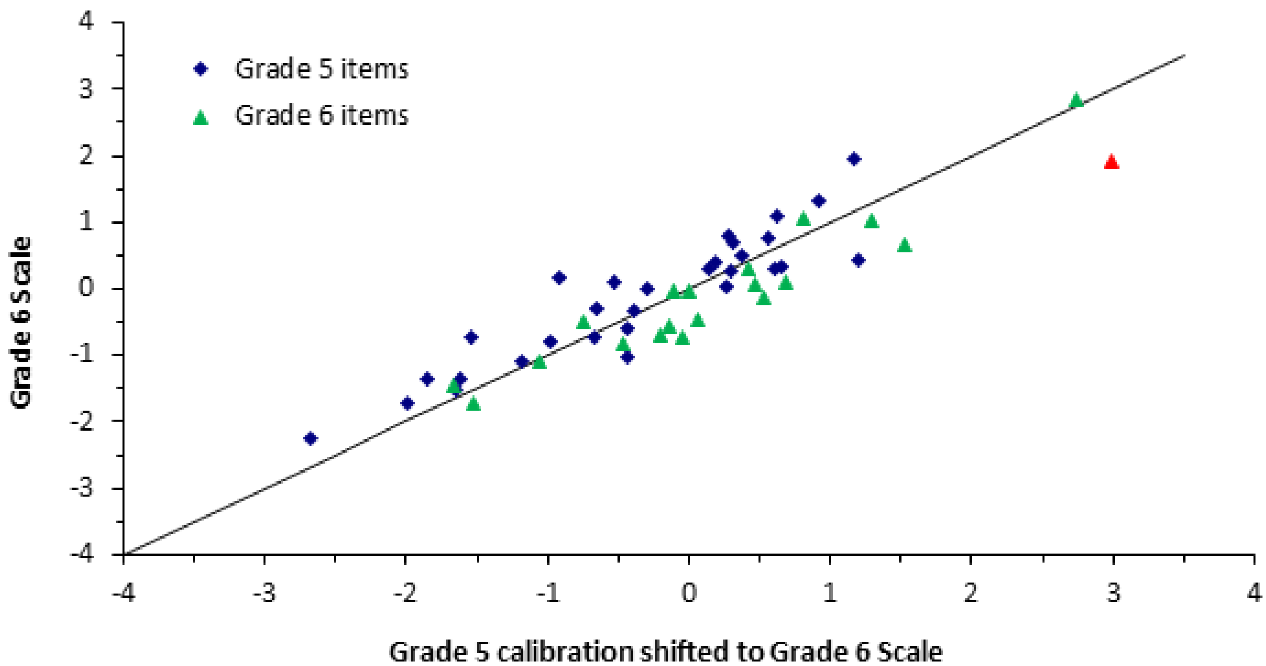


Figure C–4. CDT Mathematics: Grade 6 to Grade 7 Linking – All Links

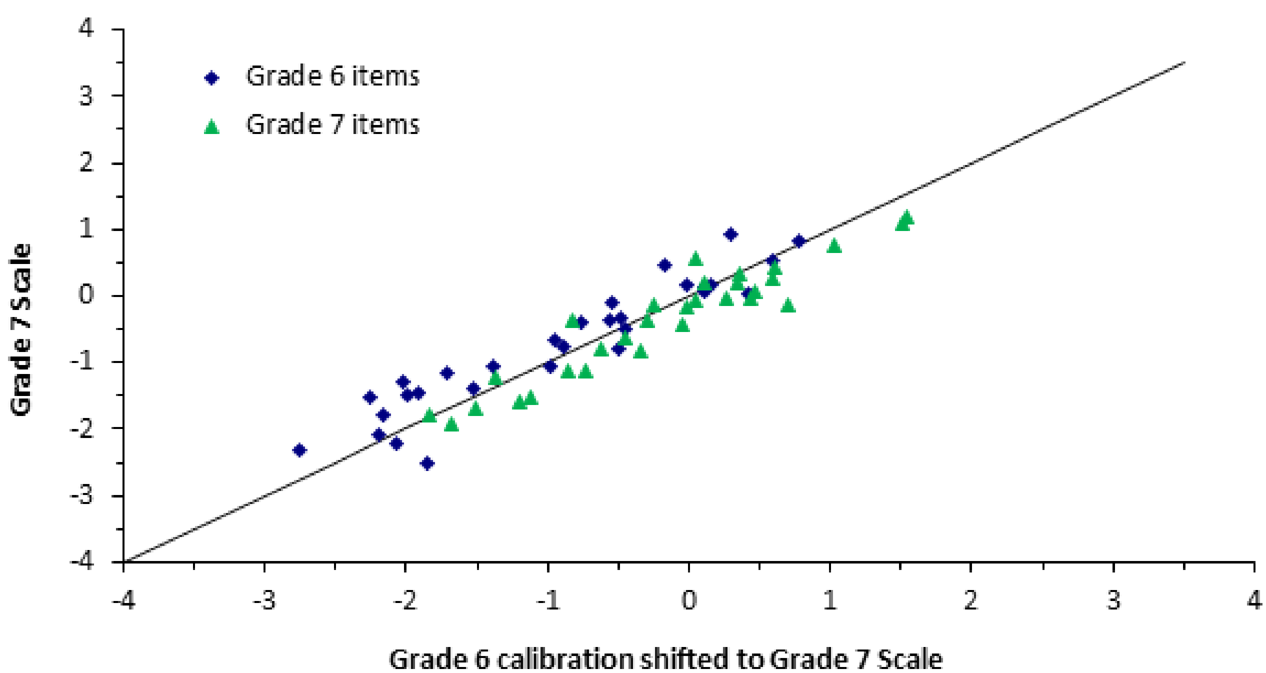


Figure C–5. CDT Mathematics: Grade 8 to Grade 7 Linking – All Links

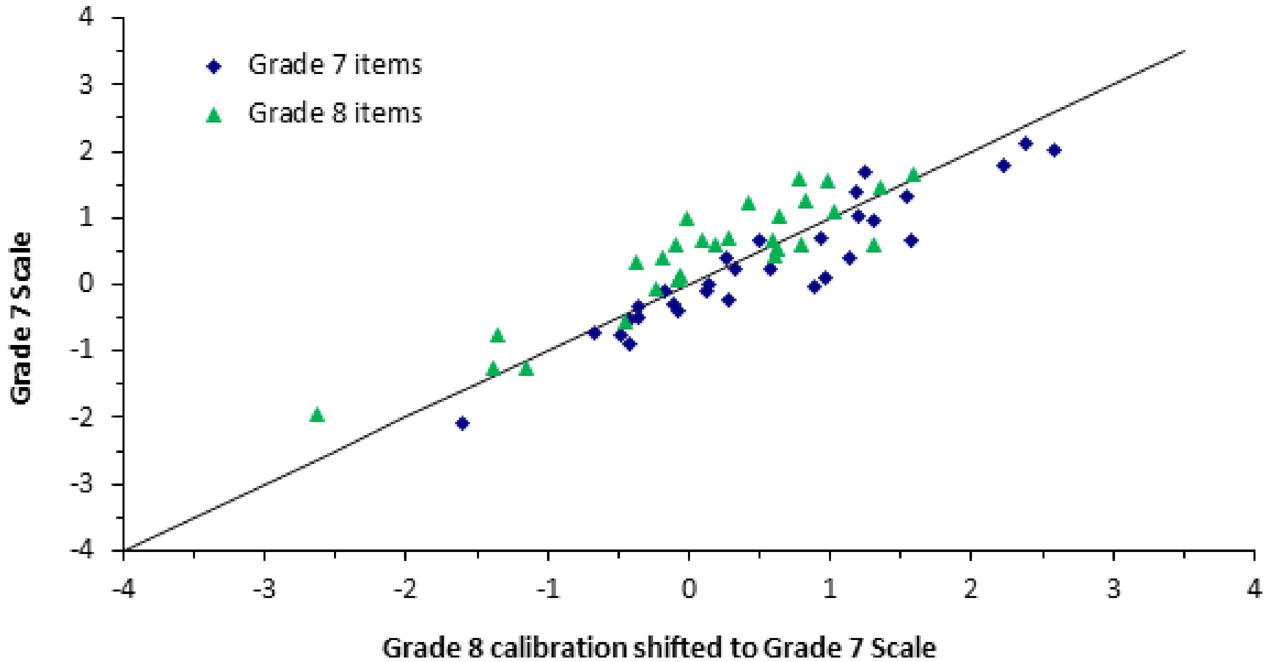


Figure C–6. CDT Mathematics: Algebra I to Grade 8 Linking – All Links

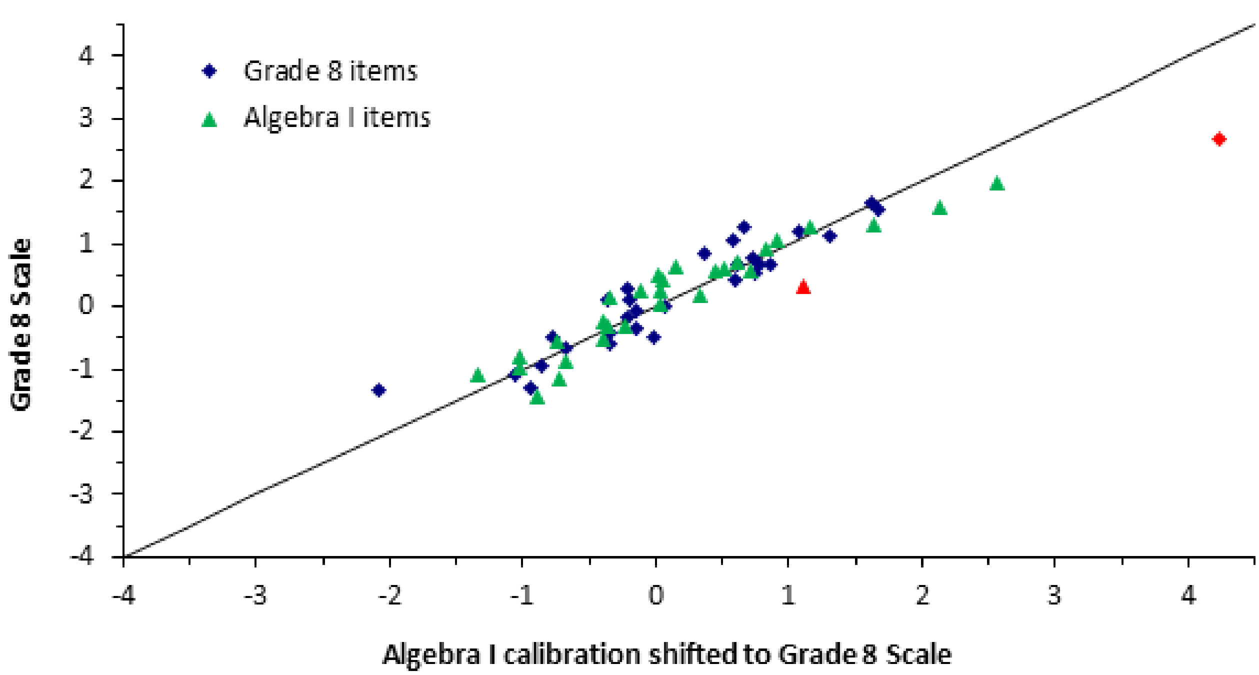


Figure C–7. CDT Mathematics: Geometry to Grade 8 Linking – All Links

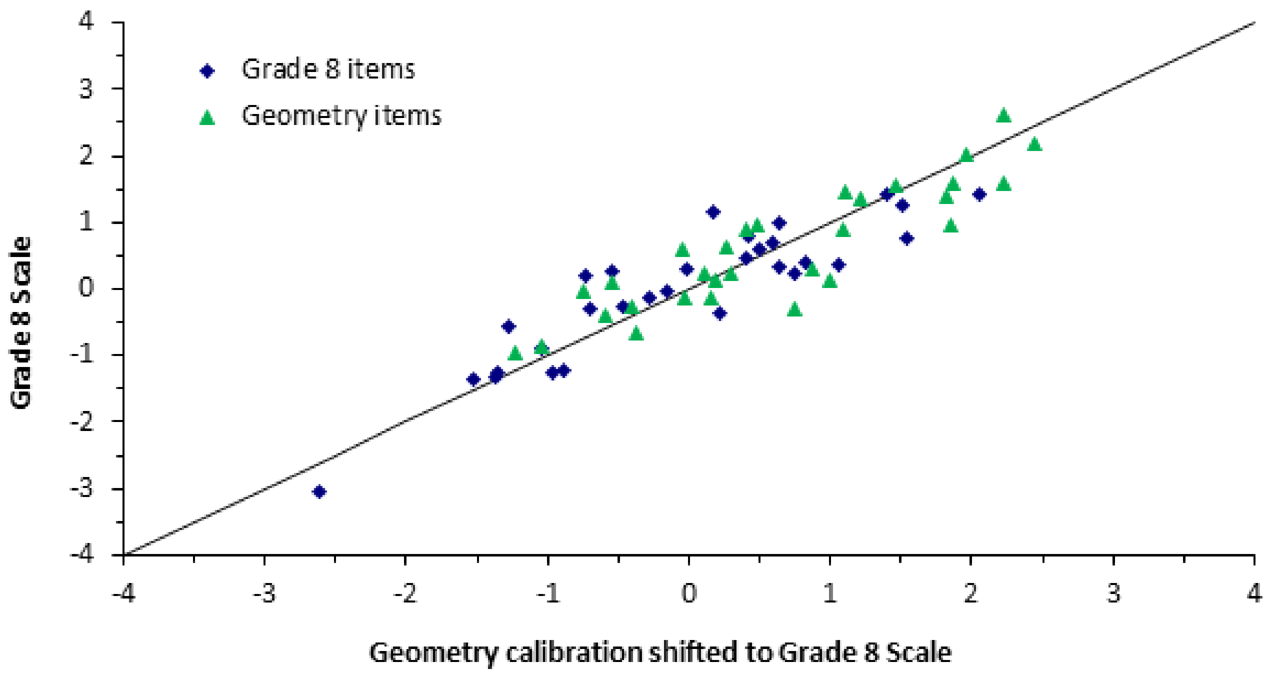
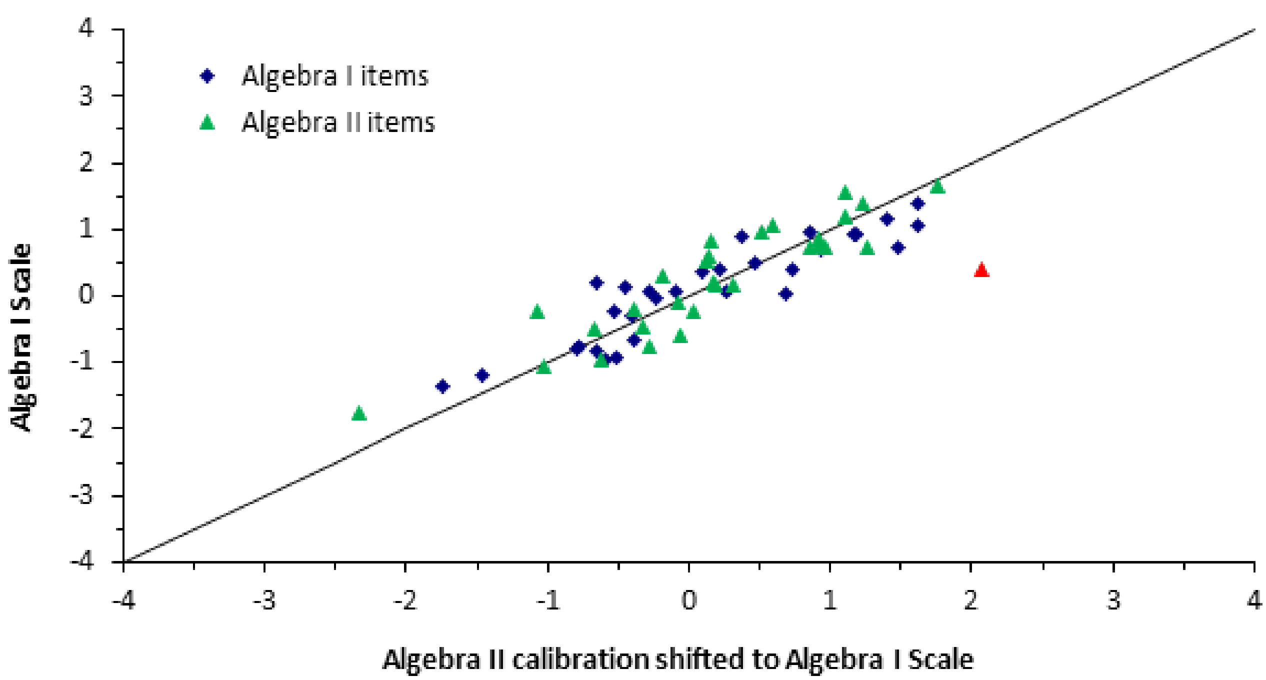


Figure C–8. CDT Mathematics: Algebra II to Algebra I Linking – All Links



READING/LITERATURE

Tables C–18 through C–23 show n-counts, eligible content code, and diagnostic category for each of the vertical linking items.

Each item was administered in two grades so there are two n-counts: one for the lower grade and one for the upper grade. For example, item 613607 is a grade 3 item used to link grades 3 and 4. It was administered 761 times on the lower grade form (grade 3) and 826 times on the upper grade form (grade 4). In some cases, a linking item was also a common item. This results in n-count that is much higher in one of the two grades. For example, item 613400 is a grade 4 item used to link grades 3 and 4. It was also a common grade 4 item (meaning it appeared on all grade 4 forms). The n-counts reflect this: Grade 3 n-count is 754 while grade 4 n-count is 6,574.

The diagnostic categories are[3]

- Comprehension
- Vocabulary
- Interpretation/Analysis Literary Elements & Devices
- Interpretation/Analysis Persuasive Techniques
- Interpretation/Analysis Organizational Skills

[3] Reading diagnostic categories changed at the start of the 2013–2014 school year due to re-alignment to the Pennsylvania Core Standards. See Chapter Thirteen for a list of the current diagnostic categories.

Table C–18. Reading/Literature Items Used to Link Grade 3 to Grade 4

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
613605	3	Grade 3 to Grade 4	5272	823	R3A.1.1.2	Vocabulary
613613	3	Grade 3 to Grade 4	5270	822	R3A.2.2.1	Vocabulary
613614	3	Grade 3 to Grade 4	5275	822	R3A.2.1.1	Vocabulary
613592	3	Grade 3 to Grade 4	5262	822	R3A.2.3.1	Comprehension
613593	3	Grade 3 to Grade 4	5263	822	R3A.2.4.1	Comprehension
613460	3	Grade 3 to Grade 4	5251	823	R3A.1.2.2	Vocabulary
613459	3	Grade 3 to Grade 4	5245	822	R3A.1.1.1	Vocabulary
613461	3	Grade 3 to Grade 4	5242	823	R3A.1.4.1	Comprehension
613463	3	Grade 3 to Grade 4	5246	823	R3B.2.1.1	I/A Literary
613462	3	Grade 3 to Grade 4	5241	823	R3A.1.5.1	Comprehension
613607	3	Grade 3 to Grade 4	761	826	R3A.1.2.1	Vocabulary
613446	3	Grade 3 to Grade 4	752	825	R3A.1.1.1	Vocabulary
613444	3	Grade 3 to Grade 4	752	824	R3B.1.1.1	I/A Literary
613445	3	Grade 3 to Grade 4	751	823	R3A.1.5.1	Comprehension
613440	3	Grade 3 to Grade 4	744	823	R3A.1.2.2	Vocabulary
613439	3	Grade 3 to Grade 4	740	823	R3A.1.1.1	Vocabulary
613438	3	Grade 3 to Grade 4	739	822	R3B.1.1.1	I/A Literary
613443	3	Grade 3 to Grade 4	739	823	R3A.1.6.1	Comprehension
613442	3	Grade 3 to Grade 4	735	822	R3A.1.5.1	Comprehension
613441	3	Grade 3 to Grade 4	733	821	R3A.1.3.1	Comprehension
613220	4	Grade 3 to Grade 4	755	6576	R4B.2.1.3	I/A Literary
613219	4	Grade 3 to Grade 4	754	6573	R4B.2.1.2	I/A Literary
613399	4	Grade 3 to Grade 4	757	6569	R4A.2.2.1	Vocabulary
613400	4	Grade 3 to Grade 4	754	6574	R4A.2.3.1	Comprehension
613402	4	Grade 3 to Grade 4	756	6568	R4B.3.2.1	I/A Persuasive
613403	4	Grade 3 to Grade 4	759	6566	R4B.3.2.1	I/A Persuasive
613401	4	Grade 3 to Grade 4	756	6570	R4A.2.6.1	Comprehension
613288	4	Grade 3 to Grade 4	757	6569	R4A.1.1.2	Vocabulary
613291	4	Grade 3 to Grade 4	756	6567	R4A.1.1.1	Vocabulary
613295	4	Grade 3 to Grade 4	757	6563	R4A.2.2.1	Vocabulary
613289	4	Grade 3 to Grade 4	756	804	R4A.1.2.1	Vocabulary
613292	4	Grade 3 to Grade 4	756	805	R4A.1.2.2	Vocabulary
613215	4	Grade 3 to Grade 4	755	805	R4A.1.2.2	Vocabulary
613213	4	Grade 3 to Grade 4	751	803	R4B.2.1.1	I/A Literary
613214	4	Grade 3 to Grade 4	752	804	R4A.1.4.1	Comprehension
613388	4	Grade 3 to Grade 4	749	827	R4A.2.3.1	Comprehension
613389	4	Grade 3 to Grade 4	750	827	R4A.2.4.1	Comprehension

Table C–18 (continued). Reading/Literature Items Used to Link Grade 3 to Grade 4

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
613391	4	Grade 3 to Grade 4	748	827	R4B.3.3.2	I/A Organizational
613392	4	Grade 3 to Grade 4	746	826	R4B.3.3.3	I/A Organizational
613390	4	Grade 3 to Grade 4	746	826	R4A.2.5.1	Comprehension

Table C–19. Reading/Literature Items Used to Link Grade 4 to Grade 5

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
613220	4	Grade 4 to Grade 5	6576	955	R4B.2.1.3	I/A Literary
613219	4	Grade 4 to Grade 5	6573	957	R4B.2.1.2	I/A Literary
613399	4	Grade 4 to Grade 5	6569	958	R4A.2.2.1	Vocabulary
613400	4	Grade 4 to Grade 5	6574	958	R4A.2.3.1	Comprehension
613402	4	Grade 4 to Grade 5	6568	957	R4B.3.2.1	I/A Persuasive
613403	4	Grade 4 to Grade 5	6566	957	R4B.3.2.1	I/A Persuasive
613401	4	Grade 4 to Grade 5	6570	958	R4A.2.6.1	Comprehension
613288	4	Grade 4 to Grade 5	6569	958	R4A.1.1.2	Vocabulary
613291	4	Grade 4 to Grade 5	6567	958	R4A.1.1.1	Vocabulary
613295	4	Grade 4 to Grade 5	6563	958	R4A.2.2.1	Vocabulary
613293	4	Grade 4 to Grade 5	830	931	R4A.2.1.2	Vocabulary
613297	4	Grade 4 to Grade 5	829	930	R4A.2.2.2	Vocabulary
613212	4	Grade 4 to Grade 5	829	930	R4A.1.1.2	Vocabulary
613211	4	Grade 4 to Grade 5	830	926	R4A.1.5.1	Comprehension
613210	4	Grade 4 to Grade 5	829	925	R4A.1.6.1	Comprehension
613369	4	Grade 4 to Grade 5	815	920	R4A.2.2.1	Vocabulary
613370	4	Grade 4 to Grade 5	813	920	R4A.2.4.1	Comprehension
613372	4	Grade 4 to Grade 5	813	919	R4B.3.1.1	I/A Persuasive
613371	4	Grade 4 to Grade 5	813	917	R4A.2.5.1	Comprehension
613373	4	Grade 4 to Grade 5	812	915	R4B.3.3.1	I/A Organizational
611554	5	Grade 4 to Grade 5	812	7546	R5A.2.1.1	Vocabulary
613007	5	Grade 4 to Grade 5	813	7530	R5B.2.1.4	I/A Literary
613005	5	Grade 4 to Grade 5	810	7528	R5B.1.1.1	I/A Literary
613006	5	Grade 4 to Grade 5	812	7526	R5A.1.6.2	Comprehension
611354	5	Grade 4 to Grade 5	811	7530	R5A.2.1.2	Vocabulary
611377	5	Grade 4 to Grade 5	808	7524	R5B.3.3.2	I/A Organizational
611376	5	Grade 4 to Grade 5	812	7526	R5B.3.1.1	I/A Persuasive
611390	5	Grade 4 to Grade 5	810	7517	R5B.3.3.3	I/A Organizational
611374	5	Grade 4 to Grade 5	807	7510	R5A.2.5.1	Comprehension
611375	5	Grade 4 to Grade 5	808	7509	R5A.2.6.2	Comprehension
611550	5	Grade 4 to Grade 5	826	931	R5A.2.1.2	Vocabulary
611245	5	Grade 4 to Grade 5	826	924	R5B.2.1.1	I/A Literary
611246	5	Grade 4 to Grade 5	826	924	R5B.2.2.1	I/A Literary
611244	5	Grade 4 to Grade 5	826	921	R5A.1.4.1	Comprehension
611269	5	Grade 4 to Grade 5	826	935	R5A.2.1.1	Vocabulary
611272	5	Grade 4 to Grade 5	824	935	R5B.3.1.1	I/A Persuasive
611270	5	Grade 4 to Grade 5	823	935	R5A.2.3.1	Comprehension

Table C–19 (continued). Reading/Literature Items Used to Link Grade 4 to Grade 5

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
611274	5	Grade 4 to Grade 5	824	935	R5B.3.3.2	I/A Organizational
611271	5	Grade 4 to Grade 5	824	934	R5A.2.6.1	Comprehension
611273	5	Grade 4 to Grade 5	824	933	R5B.3.3.1	I/A Organizational

Table C–20. Reading/Literature Items Used to Link Grade 5 to Grade 6

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
611554	5	Grade 5 to Grade 6	7546	716	R5A.2.1.1	Vocabulary
613007	5	Grade 5 to Grade 6	7530	719	R5B.2.1.4	I/A Literary
613005	5	Grade 5 to Grade 6	7528	721	R5B.1.1.1	I/A Literary
613006	5	Grade 5 to Grade 6	7526	720	R5A.1.6.2	Comprehension
611354	5	Grade 5 to Grade 6	7530	719	R5A.2.1.2	Vocabulary
611377	5	Grade 5 to Grade 6	7524	717	R5B.3.3.2	I/A Organizational
611376	5	Grade 5 to Grade 6	7526	719	R5B.3.1.1	I/A Persuasive
611390	5	Grade 5 to Grade 6	7517	718	R5B.3.3.3	I/A Organizational
611374	5	Grade 5 to Grade 6	7510	717	R5A.2.5.1	Comprehension
611375	5	Grade 5 to Grade 6	7509	717	R5A.2.6.2	Comprehension
611247	5	Grade 5 to Grade 6	928	697	R5A.1.1.1	Vocabulary
611251	5	Grade 5 to Grade 6	928	698	R5B.2.1.4	I/A Literary
611250	5	Grade 5 to Grade 6	926	697	R5B.2.1.3	I/A Literary
611249	5	Grade 5 to Grade 6	926	696	R5A.1.3.2	Comprehension
611248	5	Grade 5 to Grade 6	926	694	R5A.1.3.1	Comprehension
611309	5	Grade 5 to Grade 6	925	688	R5B.3.3.3	I/A Organizational
611278	5	Grade 5 to Grade 6	924	687	R5A.2.3.2	Comprehension
611291	5	Grade 5 to Grade 6	921	685	R5B.3.3.1	I/A Organizational
611545	5	Grade 5 to Grade 6	942	682	R5A.1.1.2	Vocabulary
611553	5	Grade 5 to Grade 6	945	680	R5A.2.1.1	Vocabulary
610132	6	Grade 5 to Grade 6	936	7111	R6A.1.2.1	Vocabulary
610135	6	Grade 5 to Grade 6	937	7105	R6B.2.1.2	I/A Literary
610133	6	Grade 5 to Grade 6	935	7086	R6A.1.4.1	Comprehension
610355	6	Grade 5 to Grade 6	935	7075	R6A.1.3.2	Comprehension
610136	6	Grade 5 to Grade 6	935	7066	R6B.2.2.2	I/A Literary
610134	6	Grade 5 to Grade 6	936	7069	R6A.1.6.1	Comprehension
612249	6	Grade 5 to Grade 6	937	7035	R6B.3.3.4	I/A Organizational
612248	6	Grade 5 to Grade 6	936	7026	R6A.2.6.2	Comprehension
607918	6	Grade 5 to Grade 6	937	7150	R6A.2.1.1	Vocabulary
607921	6	Grade 5 to Grade 6	937	7142	R6A.2.1.2	Vocabulary
607927	6	Grade 5 to Grade 6	941	713	R6A.2.2.1	Vocabulary
607917	6	Grade 5 to Grade 6	941	716	R6A.2.1.1	Vocabulary
610141	6	Grade 5 to Grade 6	938	703	R6A.1.1.1	Vocabulary
610144	6	Grade 5 to Grade 6	937	701	R6B.2.1.1	I/A Literary
610305	6	Grade 5 to Grade 6	933	700	R6A.1.3.1	Comprehension
610145	6	Grade 5 to Grade 6	932	695	R6B.2.2.2	I/A Literary
610142	6	Grade 5 to Grade 6	927	695	R6A.1.5.1	Comprehension

Table C–20 (continued). Reading/Literature Items Used to Link Grade 5 to Grade 6

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
610143	6	Grade 5 to Grade 6	925	694	R6A.1.6.1	Comprehension
610310	6	Grade 5 to Grade 6	917	726	R6B.3.2.2	I/A Persuasive
610309	6	Grade 5 to Grade 6	917	726	R6A.2.6.1	Comprehension

Table C–21. Reading/Literature Items Used to Link Grade 6 to Grade 7

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
610132	6	Grade 6 to Grade 7	7111	549	R6A.1.2.1	Vocabulary
610135	6	Grade 6 to Grade 7	7105	550	R6B.2.1.2	I/A Literary
610133	6	Grade 6 to Grade 7	7086	551	R6A.1.4.1	Comprehension
610355	6	Grade 6 to Grade 7	7075	551	R6A.1.3.2	Comprehension
610136	6	Grade 6 to Grade 7	7066	551	R6B.2.2.2	I/A Literary
610134	6	Grade 6 to Grade 7	7069	551	R6A.1.6.1	Comprehension
607921	6	Grade 6 to Grade 7	7142	550	R6A.2.1.2	Vocabulary
610327	6	Grade 6 to Grade 7	685	550	R6A.1.2.2	Vocabulary
610328	6	Grade 6 to Grade 7	682	549	R6B.2.1.4	I/A Literary
610329	6	Grade 6 to Grade 7	679	548	R6B.2.2.1	I/A Literary
610065	6	Grade 6 to Grade 7	696	551	R6A.1.1.1	Vocabulary
610071	6	Grade 6 to Grade 7	692	550	R6A.1.3.1	Comprehension
610066	6	Grade 6 to Grade 7	691	550	R6B.2.1.4	I/A Literary
610070	6	Grade 6 to Grade 7	689	551	R6A.1.3.2	Comprehension
610078	6	Grade 6 to Grade 7	687	551	R6B.2.1.3	I/A Literary
609022	6	Grade 6 to Grade 7	1433	551	R6A.1.1.2	Vocabulary
609025	6	Grade 6 to Grade 7	1431	550	R6B.2.1.1	I/A Literary
609026	6	Grade 6 to Grade 7	1431	550	R6B.2.1.4	I/A Literary
609023	6	Grade 6 to Grade 7	1431	549	R6A.1.3.1	Comprehension
609024	6	Grade 6 to Grade 7	1432	548	R6A.1.6.2	Comprehension
609658	7	Grade 6 to Grade 7	722	4978	R7A.1.1.1	Vocabulary
609663	7	Grade 6 to Grade 7	725	4976	R7B.2.2.1	I/A Literary
609661	7	Grade 6 to Grade 7	723	4971	R7A.1.5.1	Comprehension
610324	7	Grade 6 to Grade 7	724	4974	R7A.2.2.1	Vocabulary
610325	7	Grade 6 to Grade 7	723	4968	R7A.2.3.2	Comprehension
610146	7	Grade 6 to Grade 7	722	563	R7A.1.1.1	Vocabulary
610149	7	Grade 6 to Grade 7	723	565	R7B.2.1.1	I/A Literary
610147	7	Grade 6 to Grade 7	722	564	R7A.1.3.1	Comprehension
610338	7	Grade 6 to Grade 7	721	563	R7B.1.1.1	I/A Literary
610148	7	Grade 6 to Grade 7	721	564	R7A.1.6.1	Comprehension
607933	7	Grade 6 to Grade 7	705	545	R7A.1.1.2	Vocabulary
607936	7	Grade 6 to Grade 7	703	545	R7A.1.2.1	Vocabulary
609243	7	Grade 6 to Grade 7	701	544	R7B.2.1.2	I/A Literary
609053	7	Grade 6 to Grade 7	700	544	R7A.1.3.2	Comprehension
609219	7	Grade 6 to Grade 7	700	544	R7A.1.6.2	Comprehension
609037	7	Grade 6 to Grade 7	695	553	R7A.2.2.2	Vocabulary
609038	7	Grade 6 to Grade 7	692	552	R7A.2.4.1	Comprehension

Table C–21 (continued). Reading/Literature Items Used to Link Grade 6 to Grade 7

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
609039	7	Grade 6 to Grade 7	684	551	R7A.2.6.2	Comprehension
609040	7	Grade 6 to Grade 7	680	553	R7B.3.1.1	I/A Persuasive
609041	7	Grade 6 to Grade 7	678	552	R7B.3.3.1	I/A Organizational

Table C–22. Reading/Literature Items Used to Link Grade 7 to Grade 8

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
609658	7	Grade 8 to Grade 7	4978	518	R7A.1.1.1	Vocabulary
609663	7	Grade 8 to Grade 7	4976	518	R7B.2.2.1	I/A Literary
609661	7	Grade 8 to Grade 7	4971	517	R7A.1.5.1	Comprehension
610324	7	Grade 8 to Grade 7	4974	516	R7A.2.2.1	Vocabulary
610325	7	Grade 8 to Grade 7	4968	515	R7A.2.3.2	Comprehension
610146	7	Grade 8 to Grade 7	563	491	R7A.1.1.1	Vocabulary
610149	7	Grade 8 to Grade 7	565	491	R7B.2.1.1	I/A Literary
610147	7	Grade 8 to Grade 7	564	490	R7A.1.3.1	Comprehension
610338	7	Grade 8 to Grade 7	563	488	R7B.1.1.1	I/A Literary
610148	7	Grade 8 to Grade 7	564	485	R7A.1.6.1	Comprehension
614855	7	Grade 8 to Grade 7	559	516	R7A.1.1.2	Vocabulary
614859	7	Grade 8 to Grade 7	558	516	R7B.2.2.1	I/A Literary
614858	7	Grade 8 to Grade 7	559	515	R7B.2.1.2	I/A Literary
614856	7	Grade 8 to Grade 7	559	515	R7A.1.3.2	Comprehension
614857	7	Grade 8 to Grade 7	558	514	R7A.1.6.1	Comprehension
609152	7	Grade 8 to Grade 7	550	504	R7B.3.1.1	I/A Persuasive
609072	7	Grade 8 to Grade 7	551	502	R7A.2.5.1	Comprehension
609209	7	Grade 8 to Grade 7	548	500	R7B.1.1.1	I/A Literary
609210	7	Grade 8 to Grade 7	548	496	R7B.2.1.1	I/A Literary
609208	7	Grade 8 to Grade 7	548	495	R7A.1.3.1	Comprehension
609060	8	Grade 8 to Grade 7	550	4645	R8B.3.1.1	I/A Persuasive
609059	8	Grade 8 to Grade 7	550	4647	R8A.2.5.1	Comprehension
608017	8	Grade 8 to Grade 7	550	4637	R8A.1.1.2	Vocabulary
608016	8	Grade 8 to Grade 7	551	4629	R8B.2.1.2	I/A Literary
607999	8	Grade 8 to Grade 7	550	4622	R8A.1.6.2	Comprehension
610087	8	Grade 8 to Grade 7	550	510	R8B.3.3.4	I/A Organizational
610260	8	Grade 8 to Grade 7	550	509	R8B.3.3.2	I/A Organizational
610090	8	Grade 8 to Grade 7	550	511	R8B.3.3.4	I/A Organizational
610089	8	Grade 8 to Grade 7	550	511	R8B.3.3.4	I/A Organizational
610088	8	Grade 8 to Grade 7	550	510	R8B.3.3.4	I/A Organizational
609135	8	Grade 8 to Grade 7	540	531	R8B.3.2.1	I/A Persuasive
609131	8	Grade 8 to Grade 7	540	532	R8B.3.2.1	I/A Persuasive
609120	8	Grade 8 to Grade 7	539	532	R8B.3.3.2	I/A Organizational
609143	8	Grade 8 to Grade 7	539	531	R8A.2.3.2	Comprehension
609140	8	Grade 8 to Grade 7	539	532	R8A.2.6.2	Comprehension
609264	8	Grade 8 to Grade 7	539	513	R8A.1.1.2	Vocabulary
609267	8	Grade 8 to Grade 7	539	513	R8B.2.1.2	I/A Literary

Table C–22 (continued). Reading/Literature Items Used to Link Grade 7 to Grade 8

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
609265	8	Grade 8 to Grade 7	539	514	R8A.1.3.2	Comprehension
609269	8	Grade 8 to Grade 7	539	514	R8B.2.2.1	I/A Literary
609266	8	Grade 8 to Grade 7	539	515	R8A.1.6.1	Comprehension

Table C–23. Reading/Literature Items Used to Link Literature to Grade 8

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
608017	8	Literature to Grade 8	4637	255	R8A.1.1.2	Vocabulary
608016	8	Literature to Grade 8	4629	253	R8B.2.1.2	I/A Literary
607999	8	Literature to Grade 8	4622	252	R8A.1.6.2	Comprehension
610087	8	Literature to Grade 8	510	256	R8B.3.3.4	I/A Organizational
610260	8	Literature to Grade 8	509	256	R8B.3.3.2	I/A Organizational
610090	8	Literature to Grade 8	511	255	R8B.3.3.4	I/A Organizational
610089	8	Literature to Grade 8	511	255	R8B.3.3.4	I/A Organizational
610088	8	Literature to Grade 8	510	255	R8B.3.3.4	I/A Organizational
607957	8	Literature to Grade 8	502	254	R8A.1.1.2	Vocabulary
607963	8	Literature to Grade 8	501	254	R8A.1.1.1	Vocabulary
607958	8	Literature to Grade 8	516	258	R8A.1.2.1	Vocabulary
607962	8	Literature to Grade 8	516	258	R8A.1.1.1	Vocabulary
612324	8	Literature to Grade 8	516	257	R8B.3.3.4	I/A Organizational
612280	8	Literature to Grade 8	517	257	R8B.3.3.4	I/A Organizational
612279	8	Literature to Grade 8	517	257	R8A.2.6.1	Comprehension
609244	8	Literature to Grade 8	523	257	R8A.1.1.1	Vocabulary
609254	8	Literature to Grade 8	523	256	R8B.2.1.1	I/A Literary
609279	8	Literature to Grade 8	522	256	R8B.1.1.1	I/A Literary
609245	8	Literature to Grade 8	523	256	R8A.1.3.1	Comprehension
609252	8	Literature to Grade 8	523	256	R8A.1.6.1	Comprehension
608136	Lit	Literature to Grade 8	515	258	L.F.1.3.1	Comprehension
608138	Lit	Literature to Grade 8	515	258	L.F.2.3.4	I/A Literary
608137	Lit	Literature to Grade 8	512	257	L.F.2.2.1	Comprehension
614029	Lit	Literature to Grade 8	515	271	L.F.1.2.4	Vocabulary
614032	Lit	Literature to Grade 8	515	271	L.F.2.3.1	I/A Literary
614030	Lit	Literature to Grade 8	515	271	L.F.2.1.1	Comprehension
614031	Lit	Literature to Grade 8	515	271	L.F.2.2.2	Comprehension
614033	Lit	Literature to Grade 8	515	271	L.F.2.3.2	I/A Literary
614034	Lit	Literature to Grade 8	510	271	L.F.2.5.1	I/A Literary
608118	Lit	Literature to Grade 8	514	265	L.F.1.2.4	Vocabulary
610352	Lit	Literature to Grade 8	516	261	L.F.2.5.2	I/A Literary
610092	Lit	Literature to Grade 8	511	261	L.F.2.2.1	Comprehension
610094	Lit	Literature to Grade 8	509	260	L.F.2.3.6	I/A Literary
610095	Lit	Literature to Grade 8	510	259	L.F.2.4.1	I/A Literary
610093	Lit	Literature to Grade 8	509	260	L.F.2.3.4	I/A Literary
610091	Lit	Literature to Grade 8	507	260	L.F.1.1.1	Comprehension
612547	Lit	Literature to Grade 8	504	258	L.F.1.2.2	Vocabulary

Table C–23 (continued). Reading/Literature Items Used to Link Literature to Grade 8

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
612498	Lit	Literature to Grade 8	502	258	L.F.2.2.2	Comprehension
612548	Lit	Literature to Grade 8	499	258	L.F.1.3.2	Comprehension
612496	Lit	Literature to Grade 8	497	258	L.F.1.1.1	Comprehension

Tables C–24 through C–29 summarize the number of linking items by diagnostic category.

Vertical linking items are not distributed evenly across the diagnostic categories. This is due to the fact that Reading and Literature items are passage based. The three passage types (literary, persuasive, and organizational) may each have associated comprehension and vocabulary items, as well as interpretation/analysis items.

Table C–24. Number of Items Linking Grade 3 to Grade 4 by Diagnostic Category

Diagnostic Category	Grade 3 Items	Grade 4 Items	Total
Comprehension	8	6	14
Vocabulary	9	7	16
I/A Literary	3	3	6
I/A Persuasive	0	2	2
I/A Organizational	0	2	2
TOTAL	20	20	40

Table C–25. Number of Items Linking Grade 4 to Grade 5 by Diagnostic Category

Diagnostic Category	Grade 4 Items	Grade 5 Items	Total
Comprehension	6	6	12
Vocabulary	8	4	12
I/A Literary	2	4	6
I/A Persuasive	3	2	5
I/A Organizational	1	4	5
TOTAL	20	20	40

Table C–26. Number of Items Linking Grade 5 to Grade 6 by Diagnostic Category

Diagnostic Category	Grade 5 Items	Grade 6 Items	Total
Comprehension	6	8	14
Vocabulary	5	6	11
I/A Literary	4	4	8
I/A Persuasive	1	1	2
I/A Organizational	4	1	5
TOTAL	20	20	40

Table C–27. Number of Items Linking Grade 6 to Grade 7 by Diagnostic Category

Diagnostic Category	Grade 6 Items	Grade 7 Items	Total
Comprehension	7	8	15
Vocabulary	5	6	11
I/A Literary	8	4	12
I/A Persuasive	0	1	1
I/A Organizational	0	1	1
TOTAL	20	20	40

Table C–28. Number of Items Linking Grade 8 to Grade 7 by Diagnostic Category

Diagnostic Category	Grade 7 Items	Grade 8 Items	Total
Comprehension	8	6	14
Vocabulary	4	2	6
I/A Literary	7	3	10
I/A Persuasive	1	3	4
I/A Organizational	0	6	6
TOTAL	20	20	40

Table C–29. Number of Items Linking Literature to Grade 8 by Diagnostic Category

Diagnostic Category	Grade 8 Items	Literature Items	Total
Comprehension	4	9	13
Vocabulary	6	3	9
I/A Literary	3	8	11
I/A Persuasive	0	0	0
I/A Organizational	7	0	7
TOTAL	20	20	40

Table C–30. Reading/Literature Example of Vertical Linking Workbook

		Grade 4 Calibration			Grade 5 Calibration				Grade 4 on		
Item ID	**Item Grade**	**Difficulty**	**Fit**	**Displace**	**Difficulty**	**Fit**	**Displace**	**Discrepancy**	**Grade 5 Scale**	**Robust Z**	**Flag**
613220	4	0.700	1.090	0.000	0.258	1.040	-0.003	-0.442	0.290	-0.271	
613219	4	-0.063	0.980	0.000	-0.495	0.960	-0.003	-0.432	-0.473	-0.235	
613399	4	0.557	1.040	0.000	0.056	0.980	-0.003	-0.501	0.147	-0.486	
613400	4	0.589	1.020	0.000	0.131	1.000	-0.003	-0.458	0.179	-0.329	
613402	4	0.316	1.070	0.000	0.014	0.930	-0.003	-0.302	-0.094	0.238	
613403	4	0.295	0.970	0.000	-0.446	0.890	-0.003	-0.741	-0.115	-1.360	
613401	4	-0.657	0.810	0.000	-1.307	0.810	-0.003	-0.650	-1.067	-1.028	
613288	4	-0.608	0.960	0.000	-1.044	0.950	-0.003	-0.436	-1.018	-0.249	
613291	4	0.927	1.200	0.000	0.628	1.170	-0.003	-0.299	0.517	0.249	
613295	4	-1.117	0.880	0.000	-1.712	0.900	-0.003	-0.595	-1.527	-0.828	
613293	4	0.173	0.930	0.002	-0.113	0.880	0.000	-0.286	-0.237	0.297	
613297	4	0.807	1.070	0.002	0.424	0.990	0.000	-0.383	0.397	-0.056	
613212	4	1.664	1.210	0.003	1.491	1.220	0.000	-0.173	1.254	0.708	
613211	4	0.245	0.930	0.002	0.082	0.890	0.000	-0.163	-0.165	0.744	
613210	4	0.203	1.000	0.002	-0.273	0.910	0.000	-0.476	-0.207	-0.395	
613369	4	-0.556	0.900	0.004	-0.791	0.920	0.000	-0.235	-0.966	0.482	
613370	4	0.433	0.930	0.004	0.151	0.950	0.000	-0.282	0.023	0.311	
613372	4	-0.305	0.860	0.004	-0.698	0.870	0.000	-0.393	-0.715	-0.093	
613371	4	-0.513	0.910	0.004	-0.670	0.960	0.000	-0.157	-0.923	0.766	
613373	4	1.012	1.060	0.004	1.002	1.040	0.000	-0.010	0.602	1.301	
611554	5	1.180	1.170	0.003	1.126	1.050	0.000	-0.054	0.770	1.141	
613007	5	-0.124	0.900	0.003	-0.476	0.960	-0.001	-0.352	-0.534	0.056	
613005	5	2.069	1.250	0.003	2.138	1.220	0.000	0.069	1.659	1.589	
613006	5	2.275	1.240	0.003	2.367	1.120	0.000	0.092	1.865	1.673	
611354	5	0.669	1.020	0.003	0.576	1.020	-0.001	-0.093	0.259	0.999	
611377	5	0.336	1.060	0.003	0.559	1.010	-0.001	0.223	-0.074	2.149	high robust Z
611376	5	-0.804	0.840	0.003	-0.946	0.850	-0.001	-0.142	-1.214	0.821	
611390	5	1.351	1.110	0.003	1.443	1.040	0.000	0.092	0.941	1.673	
611374	5	0.109	0.930	0.003	-0.065	0.920	-0.001	-0.174	-0.301	0.704	
611375	5	0.581	1.160	0.003	0.605	1.120	-0.001	0.024	0.171	1.425	
611550	5	0.355	1.000	0.001	-0.586	0.900	0.000	-0.941	-0.055	-2.088	high robust Z
611245	5	1.298	1.070	0.001	0.635	1.030	0.000	-0.663	0.888	-1.076	
611246	5	-0.051	0.860	0.001	-0.532	0.850	0.000	-0.481	-0.461	-0.413	
611244	5	-0.152	0.910	0.001	-0.226	0.940	0.000	-0.074	-0.562	1.068	
611269	5	-0.287	0.900	0.001	-1.341	0.960	-0.006	-1.054	-0.697	-2.499	high robust Z
611272	5	-0.860	0.840	0.001	-2.081	0.930	-0.006	-1.221	-1.270	-3.107	high robust Z
611270	5	-0.274	0.900	0.001	-1.286	0.960	-0.006	-1.012	-0.684	-2.346	high robust Z
611274	5	-0.784	0.760	0.001	-2.720	0.870	-0.006	-1.936	-1.194	-5.709	high robust Z
611271	5	0.972	0.910	0.001	0.157	0.900	-0.005	-0.815	0.562	-1.629	
611273	5	2.533	1.250	0.001	2.056	1.040	-0.004	-0.477	2.123	-0.399	
	Mean	0.362			-0.048			-0.410	-0.048	-0.155	
	SD	0.868			1.107			0.415	0.868	1.511	
	SD Ratio	0.784									
	Correlation	0.940									
	Add. Constant	-0.410									
	Median							-0.368			
	Q							0.371			

Figures C–9 through C–14 are the adjacent grade linking plots. Items removed from final linking procedure are colored red.

Figure C–9. CDT Reading/Literature: Grade 3 to Grade 4 Linking – All Links

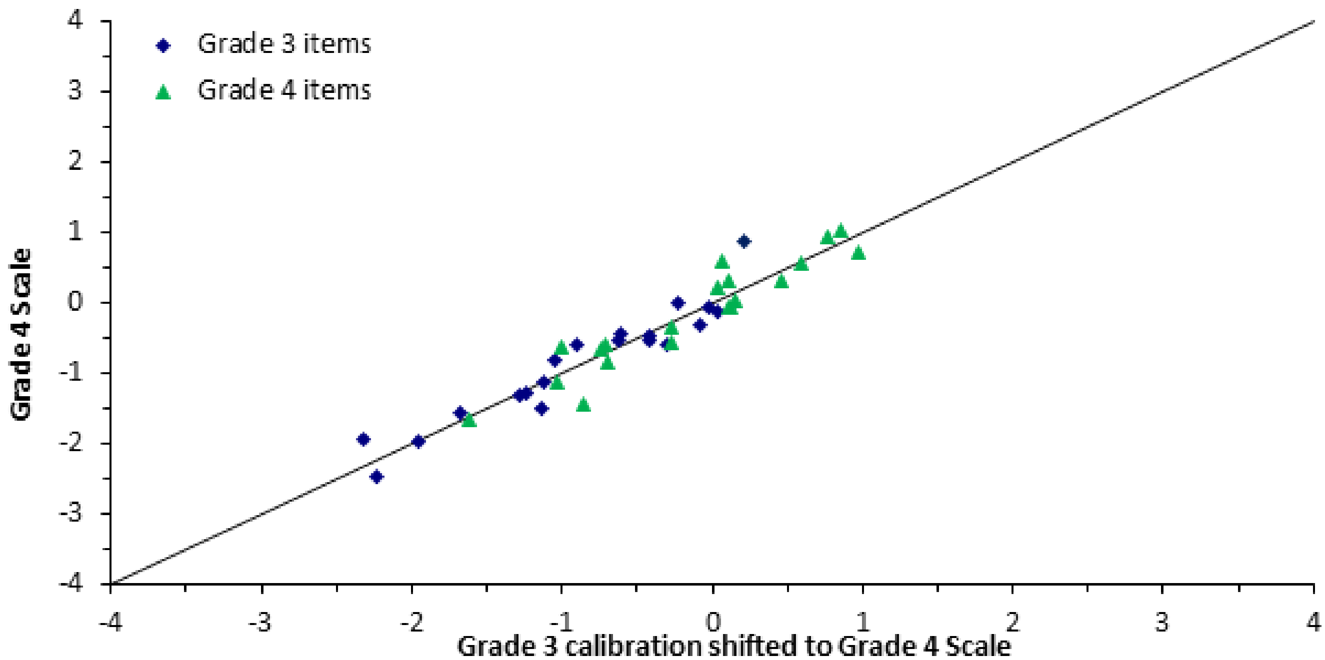


Figure C–10. CDT Reading/Literature: Grade 4 to Grade 5 Linking – All Links

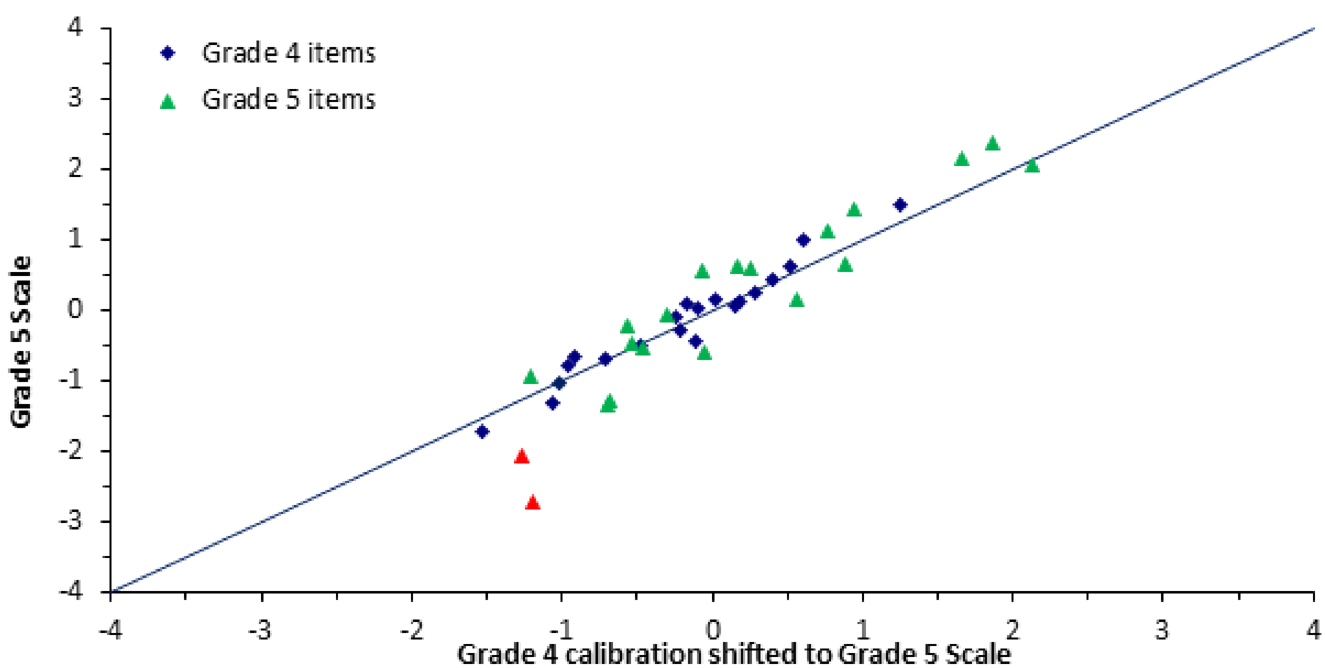


Figure C–11. CDT Reading/Literature: Grade 5 to Grade 6 Linking – All Links

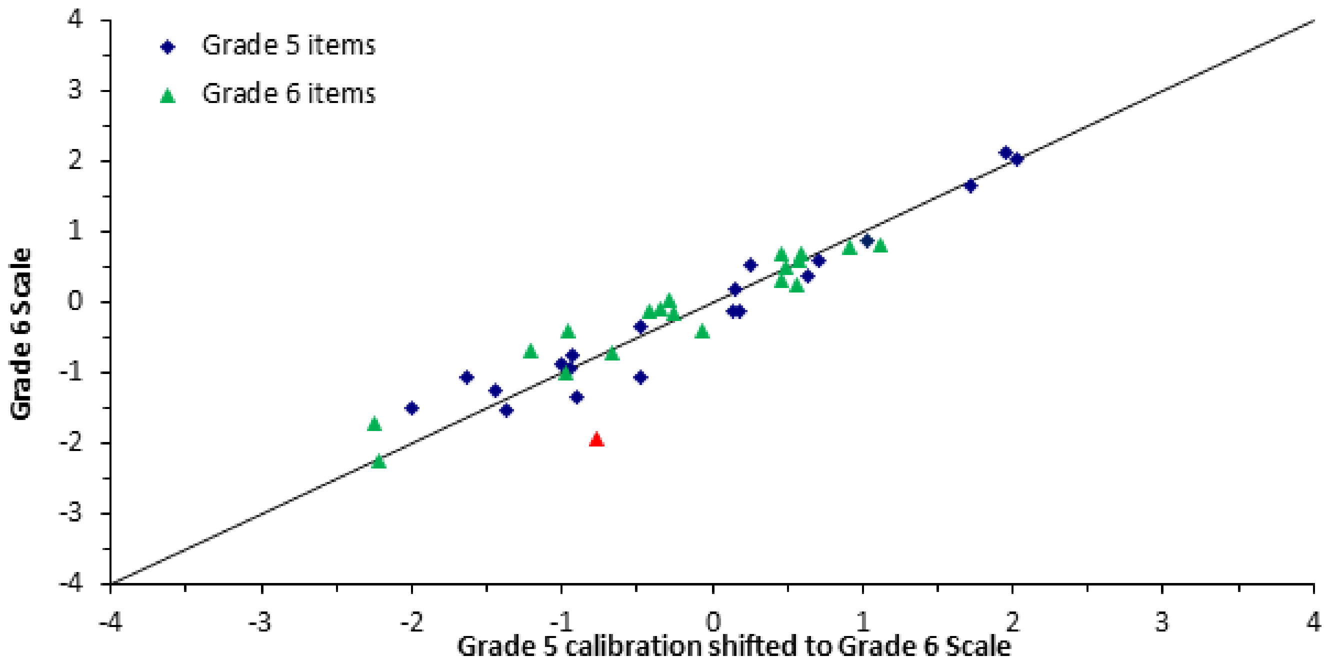


Figure C–12. CDT Reading/Literature: Grade 6 to Grade 7 Linking – All Links

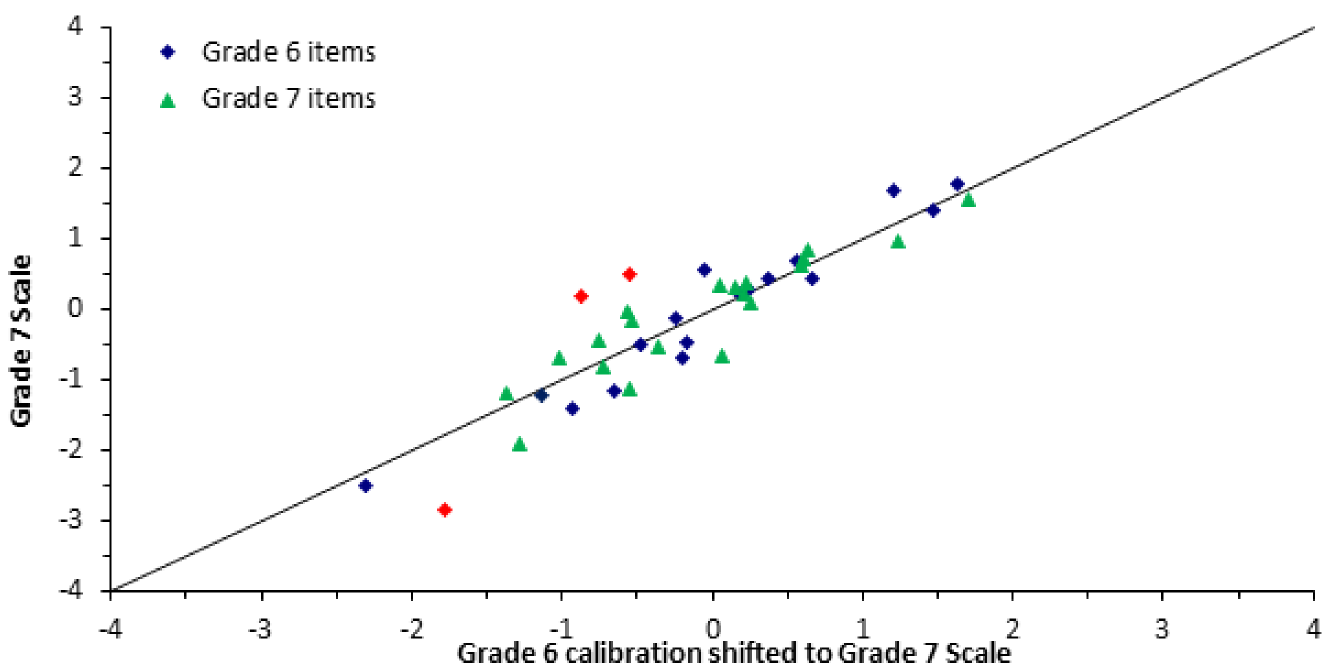


Figure C–13. CDT Reading/Literature: Grade 8 to Grade 7 Linking – All Links

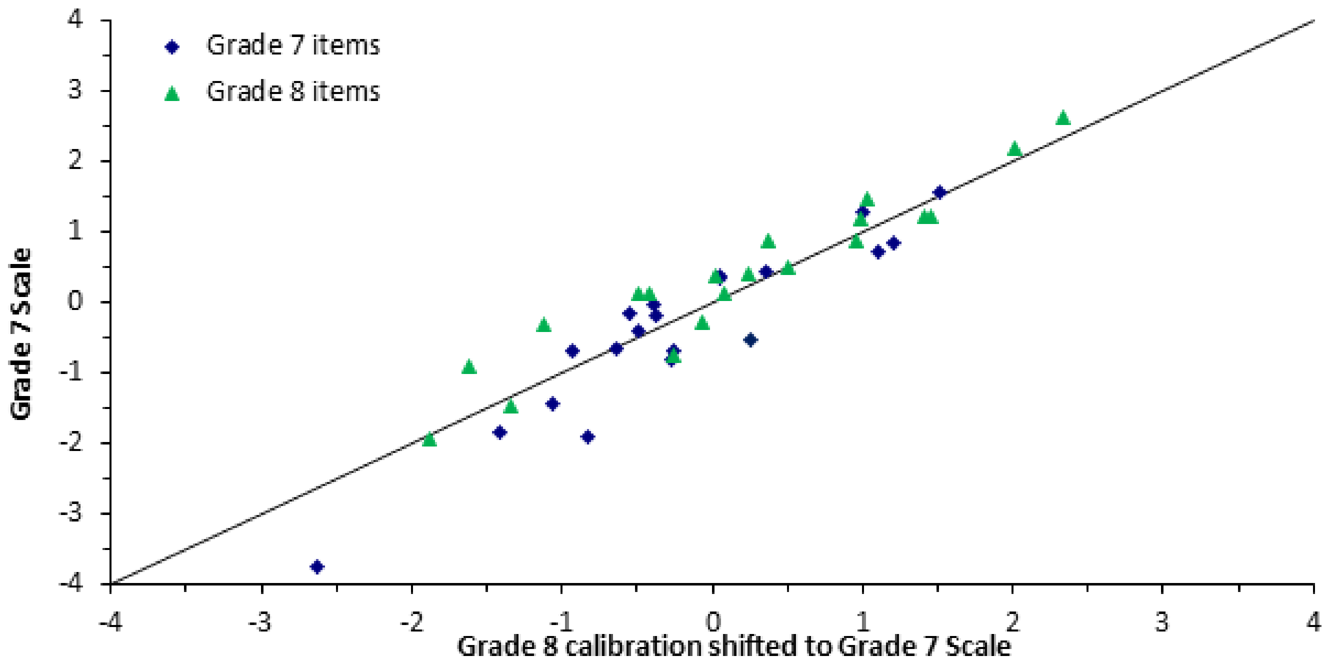
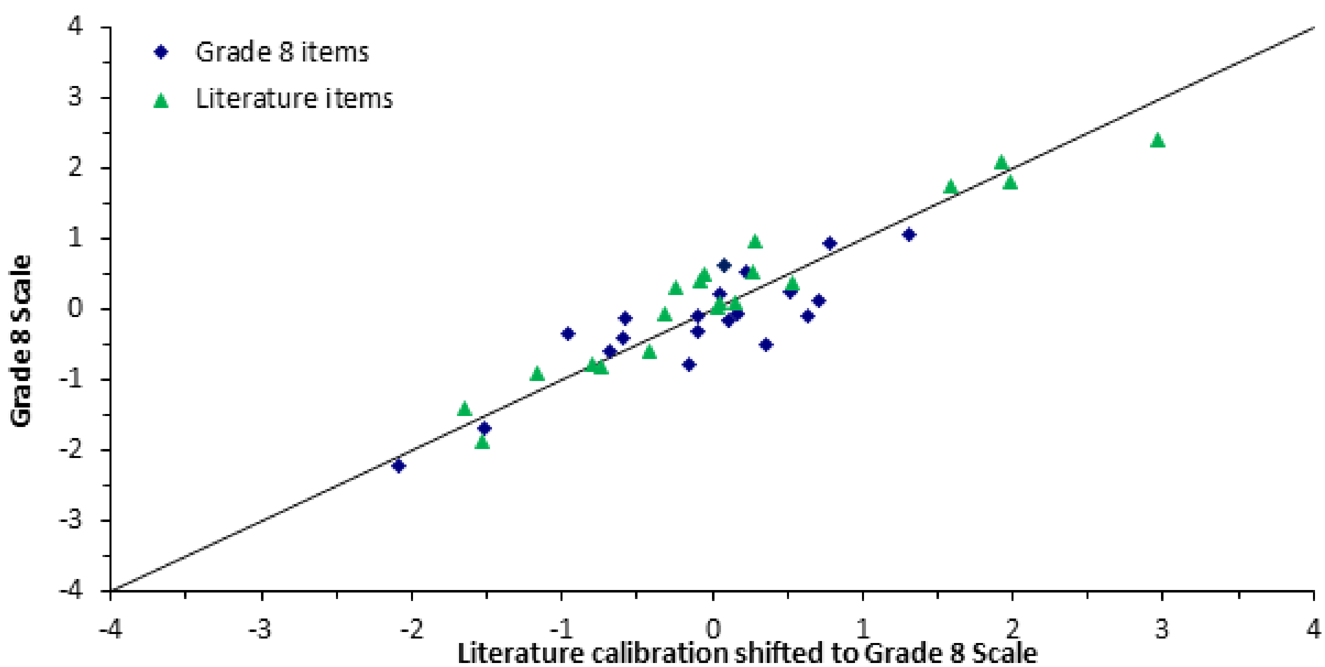


Figure C–14. CDT Reading/Literature: Literature to Grade 8 Linking – All Links



SCIENCE

Tables C–31 through C–37 show n-counts, eligible content code, and diagnostic category for each of the vertical linking items.

Each item was administered in two grades so there are two n-counts: one for the lower grade and one for the upper grade. For example, item 615315 is a grade 3 item used to link grades 3 and 4. It was administered 789 times on the lower grade form (grade 3) and 530 times on the upper grade form (grade 4). In some cases, a linking item was also a common item. This results in n-count that is much higher in one of the two grades. For example, item 617401 is a Biology item used to link Biology and grade 8. It was also a common Biology item (meaning it appeared on all Biology forms). The n-counts reflect this: Grade 8 n-count is 256 while Biology n-count is 4,874.

Diagnostic categories for Biology and Chemistry are different than diagnostic categories for grades 3 through 8 and 11 Science. Items may fall into both a Science diagnostic category and a Biology or Chemistry diagnostic category. This is shown in Tables C–36 and C–37. For example, item 615777 is in the Science diagnostic category “Biological Sciences” and the Biology diagnostic category “Basic Biological Principles”.

The Science diagnostic categories are:

- The Nature of Science
- Biological Science
- Physical Sciences
- Earth and Space Sciences

The Biology diagnostic categories are:

- Basic Biological Principles/Chemical Basis for Life
- Bioenergetics/Homeostasis and Transport
- Cell Growth and Reproduction/Genetics
- Theory of Evolution/Ecology

The Chemistry diagnostic categories are:

- Properties and Classification of Matter
- Atomic Structure and the Periodic Table
- The Mole and Chemical Bonding
- Chemical Relationships and Reactions

Table C–31. Science Items Used to Link Grade 3 to Grade 4

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category
615315	3	Grade 3 to Grade 4	789	530	S3.A.2.1.3	Nature of Science
615379	3	Grade 3 to Grade 4	790	530	S3.D.1.2.1	Earth and Space Sci.
615333	3	Grade 3 to Grade 4	770	530	S3.B.2.1.1	Biological Sci.
615395	3	Grade 3 to Grade 4	797	530	S3.D.1.3.3	Earth and Space Sci.
615363	3	Grade 3 to Grade 4	1559	530	S3.C.1.1.4	Physical Sci.
615368	3	Grade 3 to Grade 4	773	530	S3.C.2.1.2	Physical Sci.
615314	3	Grade 3 to Grade 4	796	530	S3.A.2.1.2	Nature of Science
615331	3	Grade 3 to Grade 4	782	529	S3.B.1.1.4	Biological Sci.
615324	3	Grade 3 to Grade 4	786	529	S3.A.2.1.3	Nature of Science
615347	3	Grade 3 to Grade 4	796	528	S3.B.3.1.2	Biological Sci.
615385	3	Grade 3 to Grade 4	771	525	S3.D.1.2.1	Earth and Space Sci.
615319	3	Grade 3 to Grade 4	790	524	S3.A.3.1.1	Nature of Science
615339	3	Grade 3 to Grade 4	785	524	S3.B.2.2.1	Biological Sci.
617274	3	Grade 3 to Grade 4	796	525	S3.A.1.1.1	Nature of Science
615400	3	Grade 3 to Grade 4	771	524	S3.D.3.1.1	Earth and Space Sci.
615322	3	Grade 3 to Grade 4	1572	523	S3.A.3.2.1	Nature of Science
615325	3	Grade 3 to Grade 4	773	523	S3.B.1.1.1	Biological Sci.
615376	3	Grade 3 to Grade 4	785	521	S3.D.1.1.1	Earth and Space Sci.
615327	3	Grade 3 to Grade 4	787	521	S3.B.1.1.2	Biological Sci.
615334	3	Grade 3 to Grade 4	794	521	S3.B.2.1.2	Biological Sci.
617229	4	Grade 3 to Grade 4	792	538	S4.C.1.1.2	Physical Sci.
617061	4	Grade 3 to Grade 4	793	1086	S4.A.2.1.4	Nature of Science
617244	4	Grade 3 to Grade 4	789	558	S4.D.1.1.1	Earth and Space Sci.
617095	4	Grade 3 to Grade 4	792	1097	S4.B.2.1.2	Biological Sci.
615621	4	Grade 3 to Grade 4	793	1065	S4.A.1.1.1	Nature of Science
617239	4	Grade 3 to Grade 4	793	1073	S4.C.3.1.1	Physical Sci.
617099	4	Grade 3 to Grade 4	793	539	S4.B.2.2.1	Biological Sci.
617249	4	Grade 3 to Grade 4	792	539	S4.D.1.1.3	Earth and Space Sci.
617084	4	Grade 3 to Grade 4	790	536	S4.B.1.1.1	Biological Sci.
615625	4	Grade 3 to Grade 4	791	539	S4.A.1.3.1	Nature of Science
617233	4	Grade 3 to Grade 4	780	535	S4.C.2.1.2	Physical Sci.
615632	4	Grade 3 to Grade 4	782	534	S4.A.1.3.5	Nature of Science
617245	4	Grade 3 to Grade 4	780	536	S4.D.1.1.1	Earth and Space Sci.
617096	4	Grade 3 to Grade 4	780	1092	S4.B.2.1.2	Biological Sci.
615627	4	Grade 3 to Grade 4	781	528	S4.A.1.3.2	Nature of Science
617255	4	Grade 3 to Grade 4	779	538	S4.D.1.2.3	Earth and Space Sci.
617101	4	Grade 3 to Grade 4	778	540	S4.B.3.1.1	Biological Sci.

Table C–31 (continued). Science Items Used to Link Grade 3 to Grade 4

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category
617253	4	Grade 3 to Grade 4	779	559	S4.D.1.2.2	Earth and Space Sci.
617071	4	Grade 3 to Grade 4	779	531	S4.A.3.1.4	Nature of Science
617091	4	Grade 3 to Grade 4	779	529	S4.B.1.1.5	Biological Sci.

Table C–32. Science Items Used to Link Grade 4 to Grade 5

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category
617231	4	Grade 4 to Grade 5	1099	608	S4.C.2.1.1	Physical Sci.
617060	4	Grade 4 to Grade 5	527	606	S4.A.2.1.3	Nature of Science
617092	4	Grade 4 to Grade 5	524	607	S4.B.1.1.5	Biological Sci.
617074	4	Grade 4 to Grade 5	528	608	S4.A.3.2.2	Nature of Science
617246	4	Grade 4 to Grade 5	537	606	S4.D.1.1.2	Earth and Space Sci.
617237	4	Grade 4 to Grade 5	538	607	S4.C.2.1.4	Physical Sci.
617068	4	Grade 4 to Grade 5	536	607	S4.A.3.1.3	Nature of Science
617102	4	Grade 4 to Grade 5	534	604	S4.B.3.1.2	Biological Sci.
617075	4	Grade 4 to Grade 5	557	606	S4.A.3.2.2	Nature of Science
617259	4	Grade 4 to Grade 5	523	604	S4.D.1.3.3	Earth and Space Sci.
617072	4	Grade 4 to Grade 5	539	599	S4.A.3.2.1	Nature of Science
617240	4	Grade 4 to Grade 5	540	600	S4.C.3.1.2	Physical Sci.
617112	4	Grade 4 to Grade 5	533	600	S4.B.3.3.3	Biological Sci.
617080	4	Grade 4 to Grade 5	533	601	S4.A.3.3.1	Nature of Science
617257	4	Grade 4 to Grade 5	538	600	S4.D.1.3.1	Earth and Space Sci.
617271	4	Grade 4 to Grade 5	533	600	S4.D.3.1.3	Earth and Space Sci.
617089	4	Grade 4 to Grade 5	534	600	S4.B.1.1.4	Biological Sci.
617234	4	Grade 4 to Grade 5	527	600	S4.C.2.1.3	Physical Sci.
617070	4	Grade 4 to Grade 5	537	599	S4.A.3.1.4	Nature of Science
617260	4	Grade 4 to Grade 5	531	599	S4.D.1.3.3	Earth and Space Sci.
617311	5	Grade 4 to Grade 5	532	604	S5.B.1.1.2	Biological Sci.
616317	5	Grade 4 to Grade 5	533	609	S5.A.1.1.2	Nature of Science
615950	5	Grade 4 to Grade 5	532	616	S5.B.2.1.1	Biological Sci.
617328	5	Grade 4 to Grade 5	532	610	S5.C.3.2.1	Physical Sci.
617304	5	Grade 4 to Grade 5	533	598	S5.A.2.1.2	Nature of Science
615962	5	Grade 4 to Grade 5	533	606	S5.D.3.1.1	Earth and Space Sci.
615936	5	Grade 4 to Grade 5	533	633	S5.A.1.1.2	Nature of Science
617330	5	Grade 4 to Grade 5	532	636	S5.D.1.1.1	Earth and Space Sci.
615958	5	Grade 4 to Grade 5	532	629	S5.C.1.2.1	Physical Sci.
617307	5	Grade 4 to Grade 5	528	635	S5.A.2.2.1	Nature of Science
617338	5	Grade 4 to Grade 5	540	617	S5.D.1.2.2	Earth and Space Sci.
615939	5	Grade 4 to Grade 5	538	610	S5.A.2.1.1	Nature of Science
617504	5	Grade 4 to Grade 5	541	630	S5.B.3.2.2	Biological Sci.
616969	5	Grade 4 to Grade 5	541	637	S5.C.2.1.1	Physical Sci.
615943	5	Grade 4 to Grade 5	538	627	S5.B.1.1.1	Biological Sci.
617502	5	Grade 4 to Grade 5	539	616	S5.B.2.1.3	Biological Sci.
617499	5	Grade 4 to Grade 5	540	614	S5.A.1.1.3	Nature of Science

Table C–32 (continued). Science Items Used to Link Grade 4 to Grade 5

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category
615965	5	Grade 4 to Grade 5	540	608	S5.D.1.1.1	Earth and Space Sci.
615942	5	Grade 4 to Grade 5	539	608	S5.A.3.1.1	Nature of Science
617507	5	Grade 4 to Grade 5	539	607	S5.C.2.1.2	Physical Sci.

Table C–33. Science Items Used to Link Grade 5 to Grade 6

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category
617334	5	Grade 5 to Grade 6	605	621	S5.C.2.1.4	Physical Sci.
615949	5	Grade 5 to Grade 6	629	622	S5.B.1.1.3	Biological Sci.
615938	5	Grade 5 to Grade 6	608	622	S5.A.2.1.1	Nature of Science
615963	5	Grade 5 to Grade 6	617	623	S5.D.3.1.2	Earth and Space Sci.
615946	5	Grade 5 to Grade 6	617	621	S5.B.1.1.3	Biological Sci.
616968	5	Grade 5 to Grade 6	608	620	S5.C.1.2.2	Physical Sci.
617725	5	Grade 5 to Grade 6	602	620	S5.A.2.2.2	Nature of Science
616319	5	Grade 5 to Grade 6	637	618	S5.C.1.1.2	Physical Sci.
617318	5	Grade 5 to Grade 6	629	618	S5.B.3.1.2	Biological Sci.
616970	5	Grade 5 to Grade 6	637	617	S5.C.2.1.1	Physical Sci.
617339	5	Grade 5 to Grade 6	602	624	S5.D.1.2.1	Earth and Space Sci.
617729	5	Grade 5 to Grade 6	1215	623	S5.B.2.1.4	Biological Sci.
617501	5	Grade 5 to Grade 6	606	625	S5.A.1.1.3	Nature of Science
617342	5	Grade 5 to Grade 6	616	627	S5.D.2.1.2	Earth and Space Sci.
617310	5	Grade 5 to Grade 6	628	626	S5.A.3.2.1	Nature of Science
617326	5	Grade 5 to Grade 6	636	625	S5.C.2.1.4	Physical Sci.
617305	5	Grade 5 to Grade 6	617	625	S5.A.2.1.2	Nature of Science
617323	5	Grade 5 to Grade 6	1219	626	S5.C.1.1.1	Physical Sci.
617312	5	Grade 5 to Grade 6	634	618	S5.B.1.1.2	Biological Sci.
617327	5	Grade 5 to Grade 6	629	609	S5.C.2.1.4	Physical Sci.
615560	6	Grade 5 to Grade 6	614	623	S6.C.1.2.2	Physical Sci.
615518	6	Grade 5 to Grade 6	614	625	S6.A.2.2.1	Nature of Science
617741	6	Grade 5 to Grade 6	614	616	S6.B.2.1.2	Biological Sci.
615520	6	Grade 5 to Grade 6	614	619	S6.A.2.1.1	Nature of Science
615594	6	Grade 5 to Grade 6	614	624	S6.D.2.1.1	Earth and Space Sci.
619132	6	Grade 5 to Grade 6	614	617	S6.C.2.1.3	Physical Sci.
615554	6	Grade 5 to Grade 6	613	625	S6.B.3.2.1	Biological Sci.
615557	6	Grade 5 to Grade 6	613	620	S6.C.1.2.1	Physical Sci.
615514	6	Grade 5 to Grade 6	614	624	S6.A.1.1.3	Nature of Science
615603	6	Grade 5 to Grade 6	612	616	S6.D.3.1.2	Earth and Space Sci.
615574	6	Grade 5 to Grade 6	613	620	S6.C.2.1.3	Physical Sci.
618591	6	Grade 5 to Grade 6	612	625	S6.A.1.2.2	Nature of Science
615532	6	Grade 5 to Grade 6	612	621	S6.B.2.1.2	Biological Sci.
619296	6	Grade 5 to Grade 6	611	625	S6.A.2.1.1	Nature of Science
615601	6	Grade 5 to Grade 6	610	616	S6.D.3.1.1	Earth and Space Sci.
617512	6	Grade 5 to Grade 6	610	625	S6.C.2.1.1	Physical Sci.
615540	6	Grade 5 to Grade 6	610	624	S6.B.3.1.1	Biological Sci.

Table C–33 (continued). Science Items Used to Link Grade 5 to Grade 6

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category
617508	6	Grade 5 to Grade 6	608	619	S6.B.1.1.1	Biological Sci.
615526	6	Grade 5 to Grade 6	608	620	S6.A.3.2.1	Nature of Science
619365	6	Grade 5 to Grade 6	608	618	S6.D.2.1.1	Earth and Space Sci.

Table C–34. Science Items Used to Link Grade 6 to Grade 7

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category
615535	6	Grade 6 to Grade 7	1248	428	S6.A.3.2.1	Nature of Science
615562	6	Grade 6 to Grade 7	620	428	S6.C.1.2.2	Physical Sci.
615530	6	Grade 6 to Grade 7	1234	428	S6.B.2.1.1	Biological Sci.
619141	6	Grade 6 to Grade 7	616	426	S6.D.2.1.3	Earth and Space Sci.
615510	6	Grade 6 to Grade 7	1253	425	S6.A.1.1.2	Nature of Science
618609	6	Grade 6 to Grade 7	625	426	S6.C.3.1.2	Physical Sci.
618590	6	Grade 6 to Grade 7	1243	425	S6.A.1.2.1	Nature of Science
615576	6	Grade 6 to Grade 7	621	424	S6.C.2.1.3	Physical Sci.
615551	6	Grade 6 to Grade 7	621	424	S6.C.1.2.1	Physical Sci.
615512	6	Grade 6 to Grade 7	1233	423	S6.A.1.1.3	Nature of Science
615577	6	Grade 6 to Grade 7	619	428	S6.C.3.1.1	Physical Sci.
618791	6	Grade 6 to Grade 7	1235	428	S6.A.1.2.1	Nature of Science
615531	6	Grade 6 to Grade 7	1225	428	S6.B.2.1.1	Biological Sci.
619624	6	Grade 6 to Grade 7	627	428	S6.D.3.1.2	Earth and Space Sci.
616332	6	Grade 6 to Grade 7	1228	426	S6.A.1.1.3	Nature of Science
619149	6	Grade 6 to Grade 7	618	425	S6.C.3.2.1	Physical Sci.
617533	6	Grade 6 to Grade 7	1249	427	S6.B.2.1.1	Biological Sci.
618794	6	Grade 6 to Grade 7	624	426	S6.C.3.2.1	Physical Sci.
615517	6	Grade 6 to Grade 7	1245	426	S6.A.1.2.2	Nature of Science
615567	6	Grade 6 to Grade 7	616	425	S6.C.2.1.1	Physical Sci.
616616	7	Grade 6 to Grade 7	619	428	S7.D.1.1.2	Earth and Space Sci.
615235	7	Grade 6 to Grade 7	619	430	S7.B.1.1.2	Biological Sci.
617184	7	Grade 6 to Grade 7	616	424	S7.A.1.1.1	Nature of Science
618806	7	Grade 6 to Grade 7	618	427	S7.D.2.1.1	Earth and Space Sci.
615974	7	Grade 6 to Grade 7	618	443	S7.A.1.2.1	Nature of Science
618603	7	Grade 6 to Grade 7	617	439	S7.C.2.1.3	Physical Sci.
615973	7	Grade 6 to Grade 7	617	424	S7.A.1.1.4	Nature of Science
615275	7	Grade 6 to Grade 7	614	870	S7.B.3.3.2	Biological Sci.
615238	7	Grade 6 to Grade 7	609	427	S7.B.1.1.3	Biological Sci.
618802	7	Grade 6 to Grade 7	606	430	S7.C.2.1.1	Physical Sci.
617531	7	Grade 6 to Grade 7	624	424	S7.D.1.1.2	Earth and Space Sci.
616339	7	Grade 6 to Grade 7	626	431	S7.A.2.2.3	Nature of Science
615970	7	Grade 6 to Grade 7	625	429	S7.A.1.1.2	Nature of Science
616626	7	Grade 6 to Grade 7	625	443	S7.D.3.1.1	Earth and Space Sci.
617195	7	Grade 6 to Grade 7	626	444	S7.A.1.3.1	Nature of Science
617526	7	Grade 6 to Grade 7	624	422	S7.C.1.2.2	Physical Sci.
619627	7	Grade 6 to Grade 7	625	428	S7.A.1.1.4	Nature of Science

Table C–34 (continued). Science Items Used to Link Grade 6 to Grade 7

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category
615252	7	Grade 6 to Grade 7	624	444	S7.B.2.1.3	Biological Sci.
615234	7	Grade 6 to Grade 7	620	427	S7.B.1.1.1	Biological Sci.
616039	7	Grade 6 to Grade 7	618	424	S7.C.2.1.3	Physical Sci.

Table C–35. Science Items Used to Link Grade 8 to Grade 7

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category
617198	7	Grade 8 to Grade 7	431	256	S7.A.1.3.2	Nature of Science
616619	7	Grade 8 to Grade 7	426	256	S7.D.1.2.2	Earth and Space Sci.
615969	7	Grade 8 to Grade 7	427	255	S7.A.1.1.1	Nature of Science
616038	7	Grade 8 to Grade 7	424	256	S7.C.2.1.2	Physical Sci.
616622	7	Grade 8 to Grade 7	427	254	S7.D.2.1.1	Earth and Space Sci.
615971	7	Grade 8 to Grade 7	429	254	S7.A.1.1.3	Nature of Science
615249	7	Grade 8 to Grade 7	425	255	S7.B.2.1.2	Biological Sci.
618803	7	Grade 8 to Grade 7	432	254	S7.D.2.1.1	Earth and Space Sci.
618801	7	Grade 8 to Grade 7	427	252	S7.C.2.1.3	Physical Sci.
615999	7	Grade 8 to Grade 7	423	251	S7.B.1.1.3	Biological Sci.
615308	7	Grade 8 to Grade 7	422	253	S7.C.3.1.3	Physical Sci.
618855	7	Grade 8 to Grade 7	430	254	S7.A.2.1.1	Nature of Science
618853	7	Grade 8 to Grade 7	425	254	S7.A.1.3.1	Nature of Science
616348	7	Grade 8 to Grade 7	438	254	S7.B.2.2.2	Biological Sci.
616621	7	Grade 8 to Grade 7	426	254	S7.D.1.2.3	Earth and Space Sci.
617000	7	Grade 8 to Grade 7	441	254	S7.D.3.1.3	Earth and Space Sci.
616014	7	Grade 8 to Grade 7	419	254	S7.B.3.1.1	Biological Sci.
617196	7	Grade 8 to Grade 7	441	252	S7.A.1.3.1	Nature of Science
616313	7	Grade 8 to Grade 7	430	251	S7.C.3.1.1	Physical Sci.
616007	7	Grade 8 to Grade 7	429	252	S7.B.2.1.2	Biological Sci.
615771	8	Grade 8 to Grade 7	445	262	S8.A.3.3.2	Nature of Science
617489	8	Grade 8 to Grade 7	445	257	S8.C.3.1.1	Physical Sci.
615784	8	Grade 8 to Grade 7	444	262	S8.B.2.1.1	Biological Sci.
620362	8	Grade 8 to Grade 7	444	271	S8.D.1.2.1	Earth and Space Sci.
618535	8	Grade 8 to Grade 7	444	267	S8.A.3.2.2	Nature of Science
617484	8	Grade 8 to Grade 7	444	258	S8.D.1.1.2	Earth and Space Sci.
618896	8	Grade 8 to Grade 7	443	272	S8.D.1.3.2	Earth and Space Sci.
615776	8	Grade 8 to Grade 7	443	255	S8.B.1.1.2	Biological Sci.
618543	8	Grade 8 to Grade 7	442	264	S8.C.2.2.2	Physical Sci.
617735	8	Grade 8 to Grade 7	441	287	S8.A.2.1.2	Nature of Science
617294	8	Grade 8 to Grade 7	432	262	S8.D.2.1.3	Earth and Space Sci.
617289	8	Grade 8 to Grade 7	432	255	S8.B.2.2.1	Biological Sci.
618544	8	Grade 8 to Grade 7	432	260	S8.C.2.2.2	Physical Sci.
620027	8	Grade 8 to Grade 7	432	289	S8.A.3.1.5	Nature of Science
617962	8	Grade 8 to Grade 7	432	259	S8.A.1.3.4	Nature of Science
615810	8	Grade 8 to Grade 7	432	267	S8.C.2.1.1	Physical Sci.
617279	8	Grade 8 to Grade 7	432	258	S8.B.1.1.1	Biological Sci.

Table C–35 (continued). Science Items Used to Link Grade 8 to Grade 7

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category
617293	8	Grade 8 to Grade 7	430	286	S8.D.2.1.3	Earth and Space Sci.
620020	8	Grade 8 to Grade 7	430	256	S8.A.1.1.2	Nature of Science
620400	8	Grade 8 to Grade 7	430	255	S8.B.3.2.3	Biological Sci.

Table C–36. Science Items Used to Link Biology to Grade 8

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category	Biology Diagnostic Category
615777	8	Biology to Grade 8	261	306	S8.B.1.1.3	Biological Sci.	Basic Bio. Princ.
615790	8	Biology to Grade 8	259	306	S8.B.2.1.3	Biological Sci.	Cell Growth
615817	8	Biology to Grade 8	519	306	S8.C.2.1.3	Physical Sci.	No Biology DC
620364	8	Biology to Grade 8	256	305	S8.D.1.3.1	Earth and Space Sci.	Theory of Evolution
617739	8	Biology to Grade 8	288	304	S8.A.2.1.4	Nature of Science	No Biology DC
615789	8	Biology to Grade 8	257	303	S8.B.2.1.2	Biological Sci.	Theory of Evolution
618786	8	Biology to Grade 8	257	305	S8.A.3.2.3	Nature of Science	No Biology DC
617059	8	Biology to Grade 8	266	306	S8.B.1.1.1	Biological Sci.	Basic Bio. Princ.
615791	8	Biology to Grade 8	529	305	S8.B.2.1.3	Biological Sci.	Cell Growth
617284	8	Biology to Grade 8	259	305	S8.B.2.1.3	Biological Sci.	Cell Growth
620015	8	Biology to Grade 8	254	298	S8.A.1.1.1	Nature of Science	No Biology DC
620396	8	Biology to Grade 8	256	298	S8.B.3.2.2	Biological Sci.	Theory of Evolution
617737	8	Biology to Grade 8	252	298	S8.A.2.1.3	Nature of Science	No Biology DC
617292	8	Biology to Grade 8	255	297	S8.B.2.2.2	Biological Sci.	Cell Growth
615822	8	Biology to Grade 8	542	298	S8.C.2.2.3	Physical Sci.	Theory of Evolution
620637	8	Biology to Grade 8	262	298	S8.B.3.1.3	Biological Sci.	Theory of Evolution
618540	8	Biology to Grade 8	259	298	S8.A.3.3.1	Nature of Science	No Biology DC
618548	8	Biology to Grade 8	260	298	S8.D.1.3.4	Earth and Space Sci.	Theory of Evolution
620029	8	Biology to Grade 8	522	298	S8.A.3.2.3	Nature of Science	No Biology DC
620401	8	Biology to Grade 8	259	298	S8.B.3.2.3	Biological Sci.	Theory of Evolution
617377	Bio	Biology to Grade 8	257	305	BIO.A.4.2.1	Biological Sci.	Bioenergetics
617565	Bio	Biology to Grade 8	256	311	BIO.B.4.2.5	Biological Sci.	Theory of Evolution
616111	Bio	Biology to Grade 8	256	303	BIO.A.1.2.1	Biological Sci.	Basic Bio. Princ.
617401	Bio	Biology to Grade 8	256	4874	BIO.B.2.1.1	Biological Sci.	Cell Growth
617430	Bio	Biology to Grade 8	256	309	BIO.B.3.1.1	Biological Sci.	Theory of Evolution
617395	Bio	Biology to Grade 8	256	310	BIO.B.1.2.2	Biological Sci.	Cell Growth
617013	Bio	Biology to Grade 8	257	311	BIO.A.2.2.3	Biological Sci.	Basic Bio. Princ.
617444	Bio	Biology to Grade 8	257	311	BIO.B.3.2.1	Biological Sci.	Theory of Evolution
617458	Bio	Biology to Grade 8	256	295	BIO.B.4.1.2	Biological Sci.	Theory of Evolution
617449	Bio	Biology to Grade 8	256	311	BIO.B.3.3.1	Biological Sci.	Theory of Evolution
617839	Bio	Biology to Grade 8	263	300	BIO.A.4.2.1	Biological Sci.	Bioenergetics
617462	Bio	Biology to Grade 8	263	297	BIO.B.3.3.1	Biological Sci.	Theory of Evolution
616112	Bio	Biology to Grade 8	263	305	BIO.A.1.2.1	Biological Sci.	Basic Bio. Princ.
617457	Bio	Biology to Grade 8	263	4863	BIO.B.4.1.2	Biological Sci.	Theory of Evolution
617394	Bio	Biology to Grade 8	262	296	BIO.B.1.2.2	Biological Sci.	Cell Growth
617454	Bio	Biology to Grade 8	263	310	BIO.B.4.1.1	Biological Sci.	Theory of Evolution
617349	Bio	Biology to Grade 8	263	309	BIO.A.3.1.1	Biological Sci.	Bioenergetics

Table C–36 (continued). Science Items Used to Link Biology to Grade 8

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category	Biology Diagnostic Category
617414	Bio	Biology to Grade 8	263	300	BIO.B.2.2.2	Biological Sci.	Cell Growth
617880	Bio	Biology to Grade 8	263	305	BIO.B.2.2.2	Biological Sci.	Cell Growth
617451	Bio	Biology to Grade 8	263	298	BIO.B.3.3.1	Biological Sci.	Theory of Evolution

Table C–37. Science Items Used to Link Chemistry to Grade 8

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category	Chemistry Diagnostic Category
615817	8	Chemistry to Grade 8	519	305	S8.C.2.1.3	Physical Sci.	Properties of Matter
615822	8	Chemistry to Grade 8	542	304	S8.C.2.2.3	Physical Sci.	No Chemistry DC
620029	8	Chemistry to Grade 8	522	307	S8.A.3.2.3	Nature of Science	No Chemistry DC
620025	8	Chemistry to Grade 8	258	308	S8.A.2.1.1	Nature of Science	No Chemistry DC
615819	8	Chemistry to Grade 8	261	308	S8.C.2.2.1	Physical Sci.	No Chemistry DC
620021	8	Chemistry to Grade 8	262	308	S8.A.1.1.3	Nature of Science	No Chemistry DC
615833	8	Chemistry to Grade 8	265	306	S8.D.1.1.2	Earth and Space Sci.	No Chemistry DC
615749	8	Chemistry to Grade 8	259	307	S8.A.2.2.3	Nature of Science	No Chemistry DC
620426	8	Chemistry to Grade 8	253	306	S8.B.3.3.4	Biological Sci.	No Chemistry DC
615723	8	Chemistry to Grade 8	270	305	S8.A.1.3.3	Nature of Science	No Chemistry DC
615809	8	Chemistry to Grade 8	511	307	S8.C.1.1.3	Physical Sci.	Chem. Relation.
615884	8	Chemistry to Grade 8	253	306	S8.A.2.1.1	Nature of Science	No Chemistry DC
615919	8	Chemistry to Grade 8	260	306	S8.C.1.1.1	Physical Sci.	Mole
620030	8	Chemistry to Grade 8	258	307	S8.A.3.2.3	Nature of Science	No Chemistry DC
620427	8	Chemistry to Grade 8	287	304	S8.B.3.3.4	Biological Sci.	No Chemistry DC
615927	8	Chemistry to Grade 8	266	305	S8.A.1.3.1	Nature of Science	No Chemistry DC
615826	8	Chemistry to Grade 8	262	306	S8.C.3.1.2	Physical Sci.	No Chemistry DC
620023	8	Chemistry to Grade 8	262	305	S8.A.1.3.2	Nature of Science	No Chemistry DC
615857	8	Chemistry to Grade 8	267	304	S8.D.2.1.1	Earth and Space Sci.	No Chemistry DC
615804	8	Chemistry to Grade 8	259	306	S8.C.1.1.1	Physical Sci.	Mole
616406	Chem	Chemistry to Grade 8	258	305	CHEM.A.2.1.2	Physical Sci.	Atomic Structure

Table C–37 (continued). Science Items Used to Link Chemistry to Grade 8

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category	Chemistry Diagnostic Category
618699	Chem	Chemistry to Grade 8	259	302	CHEM.B.2.1.5	Physical Sci.	Chem. Relation.
616511	Chem	Chemistry to Grade 8	259	299	CHEM.B.1.4.1	Physical Sci.	Mole
616362	Chem	Chemistry to Grade 8	258	303	CHEM.A.1.1.2	Physical Sci.	Properties of Matter
618734	Chem	Chemistry to Grade 8	259	307	CHEM.B.2.1.4	Physical Sci.	Chem. Relation.
616367	Chem	Chemistry to Grade 8	259	615	CHEM.A.1.2.2	Physical Sci.	Properties of Matter
616559	Chem	Chemistry to Grade 8	259	305	CHEM.A.1.1.5	Physical Sci.	Properties of Matter
619910	Chem	Chemistry to Grade 8	259	306	CHEM.B.1.4.2	Physical Sci.	Mole
616494	Chem	Chemistry to Grade 8	259	305	CHEM.A.1.2.3	Physical Sci.	Properties of Matter
616518	Chem	Chemistry to Grade 8	259	304	CHEM.B.2.1.5	Physical Sci.	Chem. Relation.
616427	Chem	Chemistry to Grade 8	260	306	CHEM.A.1.1.1	Physical Sci.	Properties of Matter
618726	Chem	Chemistry to Grade 8	260	309	CHEM.B.1.3.1	Physical Sci.	Mole
616365	Chem	Chemistry to Grade 8	260	301	CHEM.A.1.1.5	Physical Sci.	Properties of Matter
616516	Chem	Chemistry to Grade 8	260	306	CHEM.B.2.1.3	Physical Sci.	Chem. Relation.
618733	Chem	Chemistry to Grade 8	260	307	CHEM.B.2.1.3	Physical Sci.	Chem. Relation.
620468	Chem	Chemistry to Grade 8	260	315	CHEM.B.2.1.1	Physical Sci.	Chem. Relation.
616561	Chem	Chemistry to Grade 8	260	307	CHEM.A.1.2.2	Physical Sci.	Properties of Matter
616376	Chem	Chemistry to Grade 8	259	304	CHEM.A.2.3.1	Physical Sci.	Atomic Structure
616533	Chem	Chemistry to Grade 8	259	306	CHEM.A.2.2.2	Physical Sci.	Atomic Structure
618698	Chem	Chemistry to Grade 8	259	302	CHEM.B.2.1.4	Physical Sci.	Chem. Relation.

Tables C–38 through C–44 summarize the number of linking items by diagnostic category. Items coded in a Science diagnostic category and a Biology or Chemistry diagnostic category are noted.

Table C–38. Number of Items Linking Grade 3 to Grade 4 by Diagnostic Category

Diagnostic Category	Grade 3 Items	Grade 4 Items	Total
Nature of Science	6	6	12
Biological Sciences	7	6	13
Physical Sciences	2	3	5
Earth and Space Sciences	5	5	10
TOTAL	20	20	40

Table C–39. Number of Items Linking Grade 4 to Grade 5 by Diagnostic Category

Diagnostic Category	Grade 4 Items	Grade 5 Items	Total
Nature of Science	7	7	14
Biological Sciences	4	5	9
Physical Sciences	4	4	8
Earth and Space Sciences	5	4	9
TOTAL	20	20	40

Table C–40. Number of Items Linking Grade 5 to Grade 6 by Diagnostic Category

Diagnostic Category	Grade 5 Items	Grade 6 Items	Total
Nature of Science	5	6	11
Biological Sciences	5	5	10
Physical Sciences	7	5	12
Earth and Space Sciences	3	4	7
TOTAL	20	20	40

Table C–41. Number of Items Linking Grade 6 to Grade 7 by Diagnostic Category

Diagnostic Category	Grade 6 Items	Grade 7 Items	Total
Nature of Science	7	7	14
Biological Sciences	3	5	8
Physical Sciences	8	4	12
Earth and Space Sciences	2	4	6
TOTAL	20	20	40

Table C–42. Number of Items Linking Grade 8 to Grade 7 by Diagnostic Category

Diagnostic Category	Grade 7 Items	Grade 8 Items	Total
Nature of Science	6	6	12
Biological Sciences	5	5	10
Physical Sciences	4	4	8
Earth and Space Sciences	5	5	10
TOTAL	20	20	40

Table C–43a. Number of Items Linking Biology to Grade 8 by Diagnostic Category

Diagnostic Category	Grade 8 Items	Biology Items	Total
Nature of Science	6	0	6
Biological Sciences	10	20	30
Physical Sciences	2	0	2
Earth and Space Sciences	2	0	2
No Grade 8 DC	0	0	0
TOTAL	20	20	40

Table C–43b. Number of Items Linking Biology to Grade 8 by Diagnostic Category

Diagnostic Category	Grade 8 Items	Biology Items	Total
Basic Biological Principles	2	3	5
Bioenergetics	0	3	3
Cell Growth	4	5	9
Theory of Evolution	7	9	16
No Biology DC	7	0	7
TOTAL	20	20	40

Table C–44a. Number of Items Linking Chemistry to Grade 8 by Diagnostic Category

Diagnostic Category	Grade 8 Items	Chemistry Items	Total
Nature of Science	9	0	9
Biological Sciences	2	0	2
Physical Sciences	7	20	27
Earth and Space Sciences	2	0	2
No Grade 8 DC	0	0	0
TOTAL	20	20	40

Table C–44b. Number of Items Linking Chemistry to Grade 8 by Diagnostic Category

Diagnostic Category	Grade 8 Items	Chemistry Items	Total
Properties of Matter	1	7	8
Atomic Structure	0	3	3
The Mole	2	3	5
Chemical Relationships	1	7	8
No Chemistry DC	16	0	16
TOTAL	20	20	40

Table C–45. Science Example of Vertical Linking Workbook

		Grade 4 Calibration			Grade 5 Calibration				Grade 4 on		
Item ID	Item Grade	Difficulty	Fit	Displace	Difficulty	Fit	Displace	Discrepancy	Grade 5 Scale	Robust Z	Flag
617231	4	-0.669	0.980	0.001	-1.440	1.040	-0.004	-0.771	-1.442	-0.097	
617060	4	0.409	1.030	-0.002	-0.267	1.050	-0.003	-0.676	-0.364	0.312	
617092	4	-0.519	1.040	-0.002	-1.314	0.930	-0.004	-0.795	-1.292	-0.200	
617074	4	-0.048	0.950	-0.002	-0.773	1.000	-0.003	-0.725	-0.821	0.101	
617246	4	0.952	0.930	0.000	-0.093	0.900	-0.003	-1.045	0.179	-1.275	
617237	4	0.497	0.970	0.000	-0.250	0.950	-0.003	-0.747	-0.276	0.006	
617068	4	-0.016	1.030	0.002	-0.396	0.980	-0.003	-0.380	-0.789	1.585	
617102	4	2.758	1.090	-0.006	1.678	1.100	-0.003	-1.080	1.985	-1.426	
617075	4	0.654	1.030	-0.001	0.375	1.010	-0.003	-0.279	-0.119	2.019	high robust Z
617259	4	1.107	1.120	-0.001	0.532	1.070	-0.003	-0.575	0.334	0.746	
617072	4	0.683	0.970	0.004	-0.653	0.950	-0.002	-1.336	-0.090	-2.526	high robust Z
617240	4	0.983	1.080	0.004	0.131	1.100	-0.002	-0.852	0.210	-0.445	
617112	4	0.827	0.970	-0.001	0.145	0.930	-0.002	-0.682	0.054	0.286	
617080	4	1.924	1.230	-0.001	1.183	1.110	-0.002	-0.741	1.151	0.032	
617257	4	0.184	0.950	0.004	-0.368	0.960	-0.002	-0.552	-0.589	0.845	
617271	4	0.518	0.980	0.002	-0.502	0.920	-0.002	-1.020	-0.255	-1.168	
617089	4	0.146	1.140	-0.006	-0.345	1.080	-0.002	-0.491	-0.627	1.107	
617234	4	0.420	0.990	-0.002	0.000	1.060	-0.002	-0.420	-0.353	1.413	
617070	4	-0.383	0.940	0.000	-1.133	0.920	-0.002	-0.750	-1.156	-0.006	
617260	4	1.940	1.120	0.003	1.201	1.140	-0.002	-0.739	1.167	0.041	
617311	5	-0.320	1.000	0.002	-0.902	0.970	-0.001	-0.582	-1.093	0.716	
616317	5	-0.027	1.040	0.002	-0.296	1.080	0.001	-0.269	-0.800	2.062	high robust Z
615950	5	0.038	0.970	0.002	-0.902	0.920	0.001	-0.940	-0.735	-0.823	
617328	5	-0.257	0.960	0.002	-0.859	0.860	0.001	-0.602	-1.030	0.630	
617304	5	1.292	1.120	0.002	0.486	1.020	0.001	-0.806	0.519	-0.247	
615962	5	-0.868	0.940	0.002	-1.223	0.930	0.001	-0.355	-1.641	1.692	
615936	5	-0.152	0.990	0.002	-1.059	0.890	0.003	-0.907	-0.925	-0.682	
617330	5	0.732	0.940	0.002	-0.012	0.840	-0.002	-0.744	-0.041	0.019	
615958	5	0.180	1.070	0.002	-0.560	1.010	0.003	-0.740	-0.593	0.037	
617307	5	1.109	0.950	0.002	0.289	0.970	-0.002	-0.820	0.336	-0.307	
617338	5	0.456	0.940	0.005	-0.715	0.920	0.001	-1.171	-0.317	-1.817	
615939	5	0.484	0.980	0.005	-0.418	0.850	-0.002	-0.902	-0.289	-0.660	
617504	5	2.443	0.990	0.005	1.115	1.020	0.004	-1.328	1.670	-2.492	high robust Z
616969	5	-0.111	1.080	0.005	-0.812	1.030	-0.002	-0.701	-0.884	0.204	
615943	5	0.657	1.070	0.005	-0.391	0.940	0.003	-1.048	-0.116	-1.288	
617502	5	0.997	0.980	0.005	0.107	0.970	0.001	-0.890	0.224	-0.608	
617499	5	0.794	1.030	0.005	-0.130	1.000	-0.002	-0.924	0.021	-0.755	
615965	5	1.460	0.920	0.005	0.316	0.920	-0.001	-1.144	0.687	-1.701	
615942	5	-1.725	0.940	0.005	-2.577	0.940	-0.001	-0.852	-2.498	-0.445	
617507	5	0.870	1.230	0.005	0.340	1.130	0.001	-0.530	0.097	0.940	
	Mean	0.510			-0.262			-0.773	-0.262	-0.104	
	SD	0.875			0.810			0.259	0.875	1.114	
	SD Ratio	1.080									
	Correlation	0.956									
	Add. Constant	-0.773									
	Median							-0.749			
	Q							0.314			

Figures C–15 through C–21 are the adjacent grade linking plots. Items removed from final linking procedure are colored red.

Figure C–15. CDT Science: Grade 3 to Grade 4 Linking – All Links

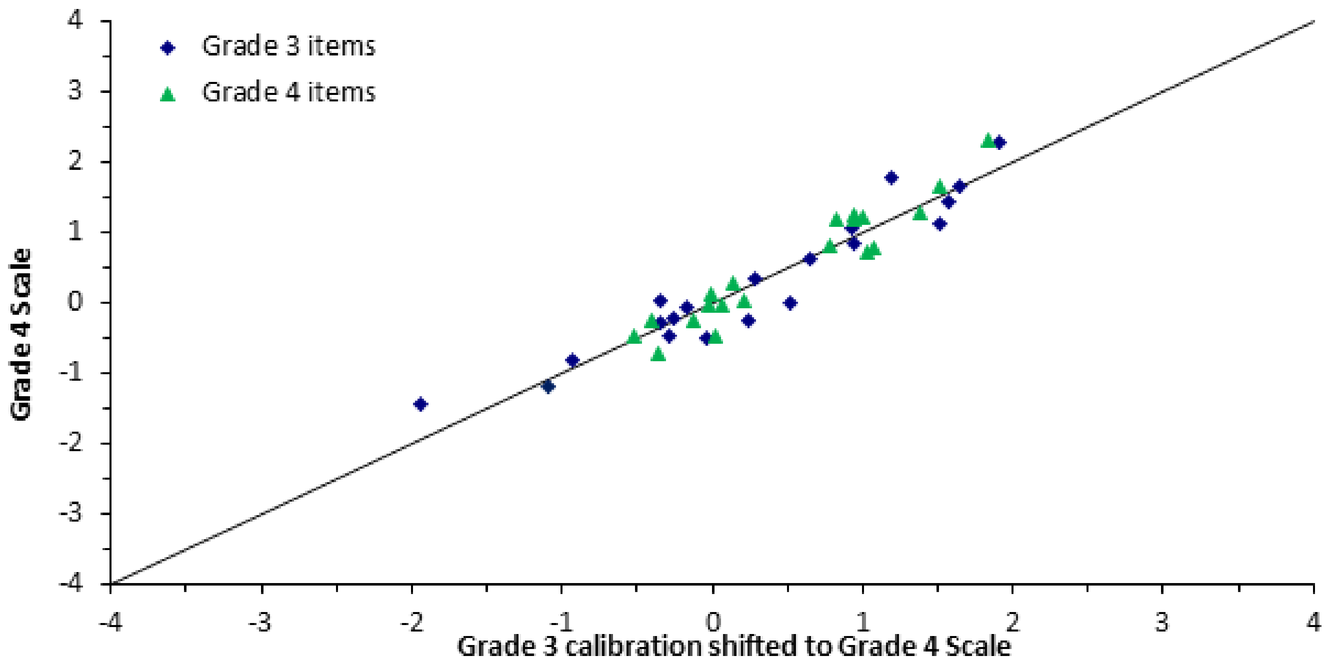


Figure C–16. CDT Science: Grade 4 to Grade 5 Linking – All Links

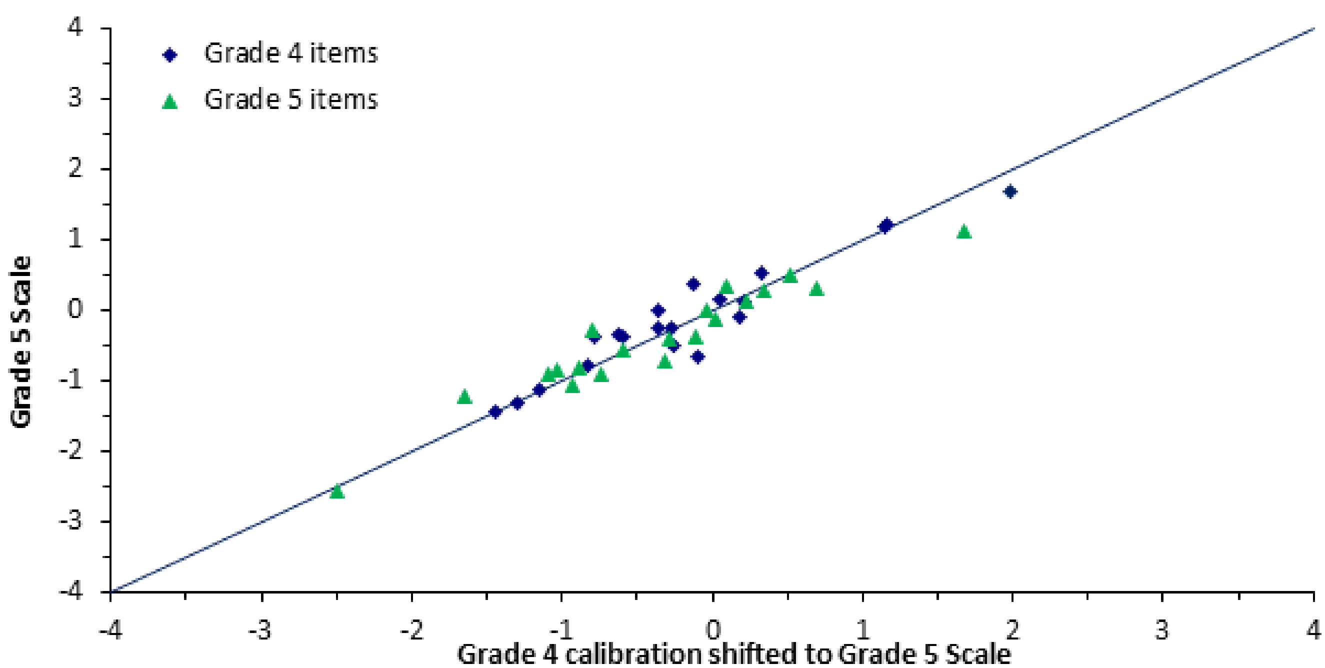


Figure C–17. CDT Science: Grade 5 to Grade 6 Linking – All Links

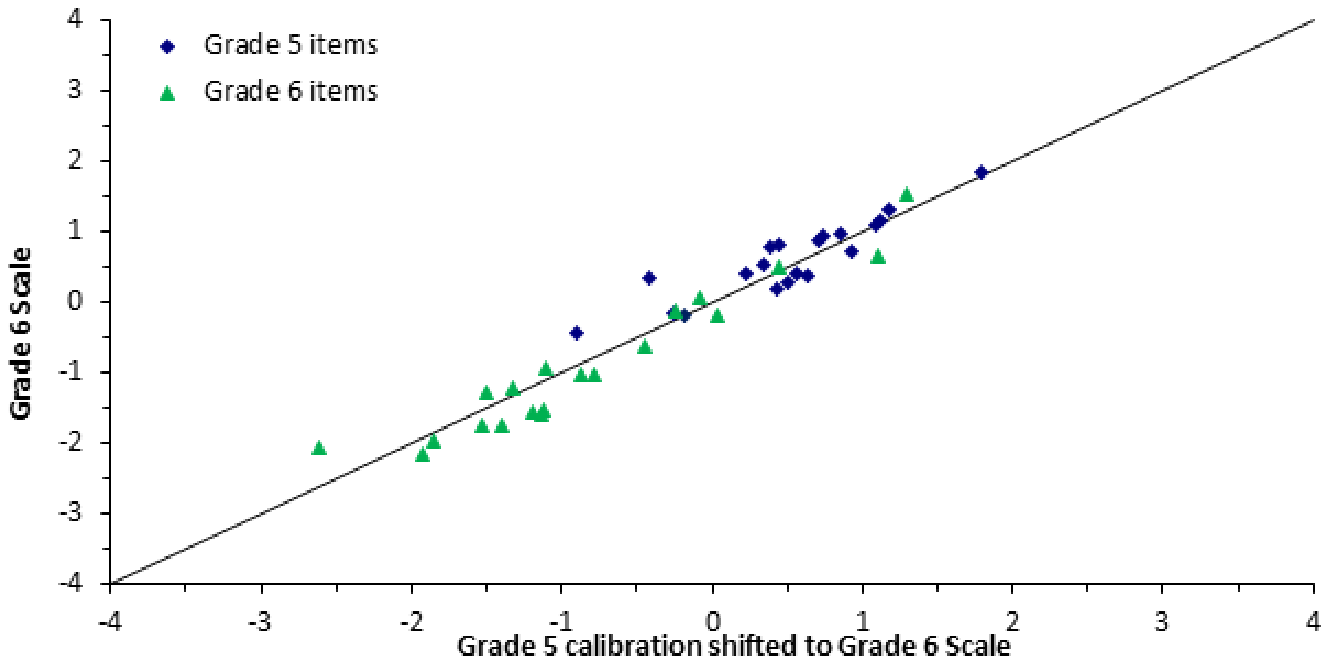


Figure C–18. CDT Science: Grade 6 to Grade 7 Linking – All Links

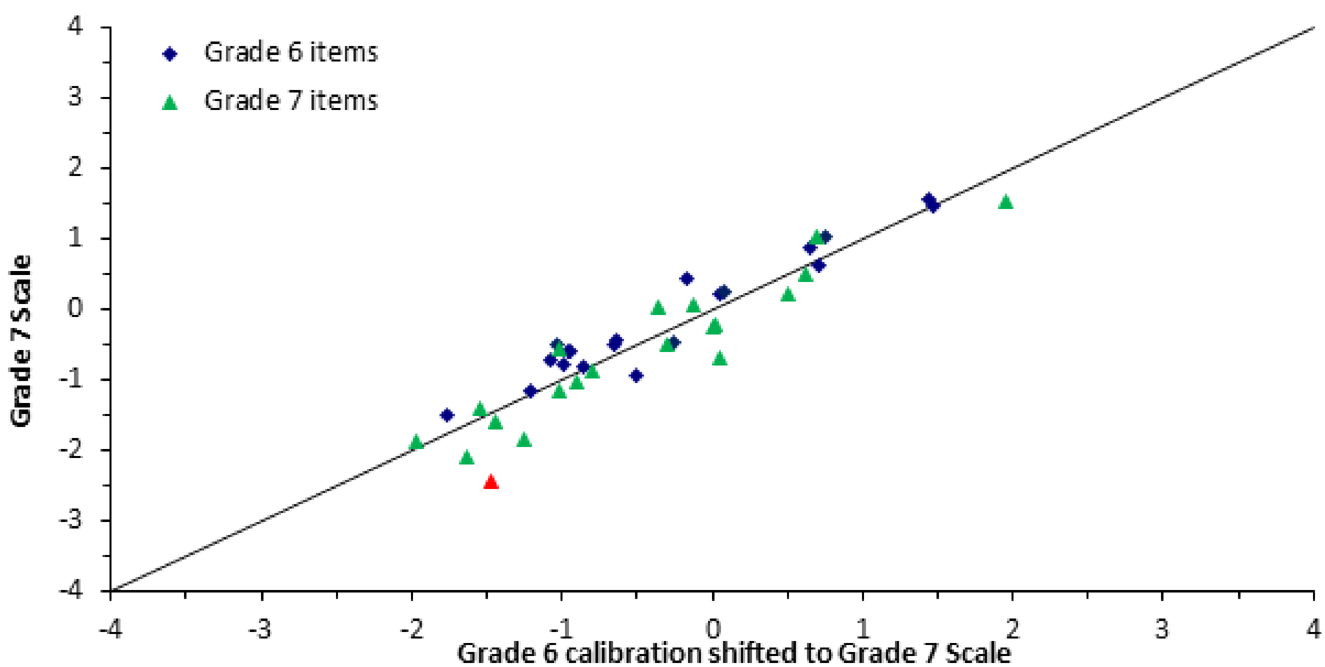


Figure C–19. CDT Science: Grade 8 to Grade 7 Linking – All Links

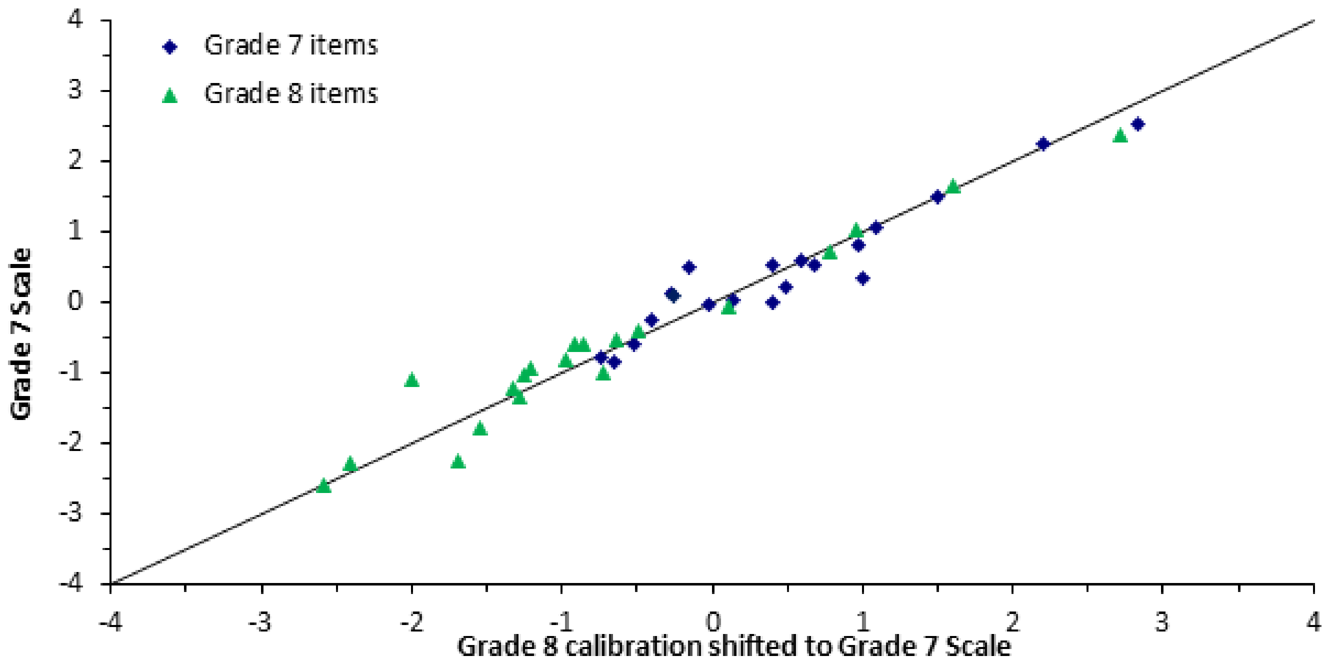


Figure C–20. CDT Science: Biology to Grade 8 Linking – All Links

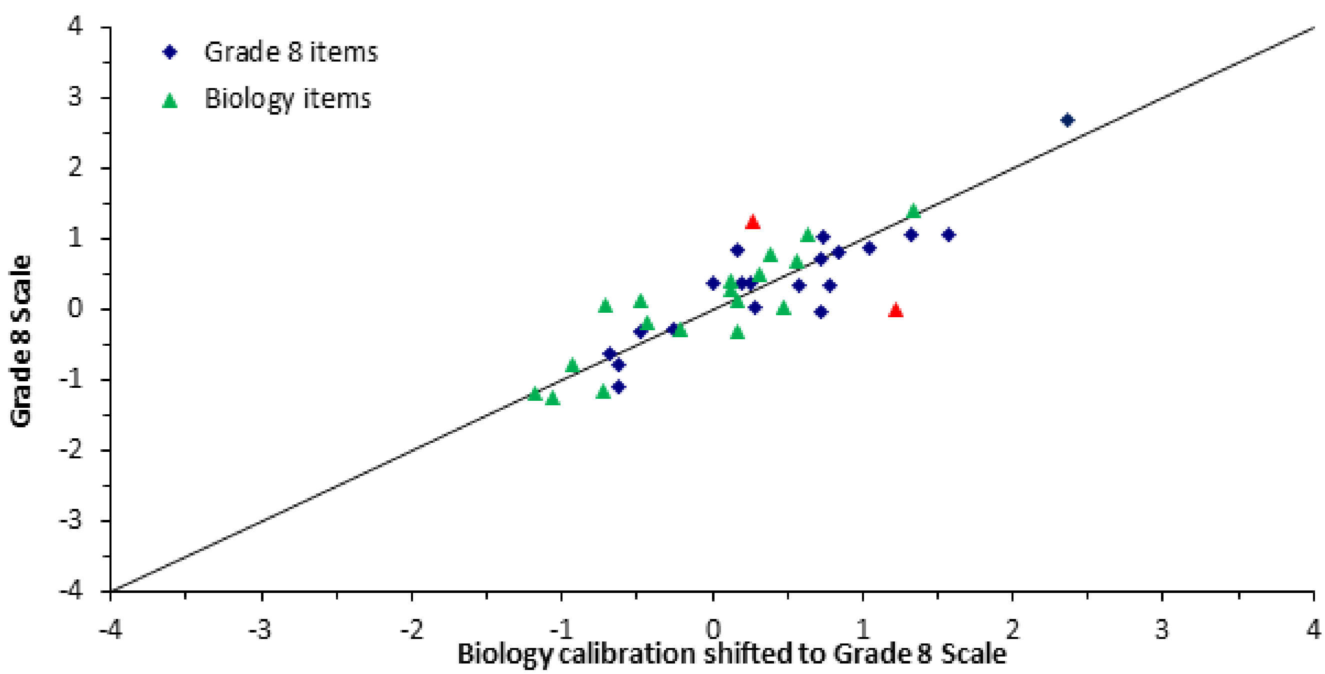
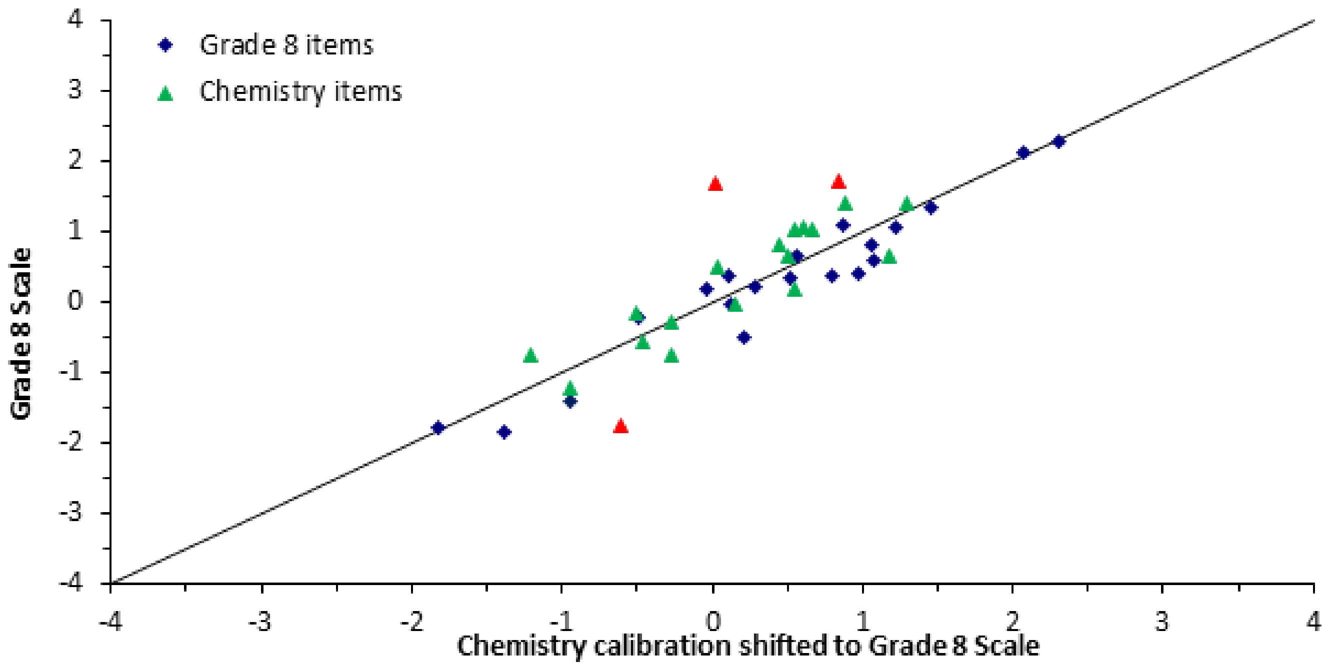


Figure C–21. CDT Science: Chemistry to Grade 8 Linking – All Links



WRITING/ENGLISH COMPOSITION

Tables C–46 through C–51 show n-counts, eligible content code, and diagnostic category for each of the vertical linking items.

Each item was administered in two grades so there are two n-counts: one for the lower grade and one for the upper grade. For example, item 626547 is a grade 3 item used to link grades 3 and 4. It was administered 274 times on the lower grade form (grade 3) and 234 times on the upper grade form (grade 4).

The diagnostic categories are[4]:

- Quality of Writing: Focus and Content
- Quality of Writing: Organization and Style
- Quality of Writing: Editing
- Conventions: Spelling, Capitalization, and Punctuation
- Conventions: Grammar and Sentence Formation

[4] Writing diagnostic categories changed at the start of the 2013–2014 school year due to re-alignment to the Pennsylvania Core Standards. See Chapter Thirteen for a list of the current diagnostic categories.

Table C–46. Writing/English Composition Items Used to Link Grade 3 to Grade 4

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Writing/Composition Diagnostic Category
626547	3	Grade 3 to Grade 4	274	234	W.1.5.3.F.b	Spell., Cap., Punct.
621012	3	Grade 3 to Grade 4	276	234	W.1.5.3.F.d	Gram. and Sent.
634030	3	Grade 3 to Grade 4	277	234	W.1.5.3.F.a	Spell., Cap., Punct.
634160	3	Grade 3 to Grade 4	275	234	W.1.5.3.D	Org and Style
623056	3	Grade 3 to Grade 4	275	234	W.1.5.3.C	Org and Style
621006	3	Grade 3 to Grade 4	277	234	W.1.5.3.F.d	Gram. and Sent.
624801	3	Grade 3 to Grade 4	276	234	W.1.5.3.A	Focus and Content
623023	3	Grade 3 to Grade 4	274	234	W.1.5.3.F.d	Gram. and Sent.
622985	3	Grade 3 to Grade 4	274	234	W.1.5.3.B	Focus and Content
624847	3	Grade 3 to Grade 4	277	234	W.1.5.3.F.c	Spell., Cap., Punct.
624849	3	Grade 3 to Grade 4	276	232	W.1.5.3.F.b	Spell., Cap., Punct.
622465	3	Grade 3 to Grade 4	277	232	W.1.5.3.F.d	Gram. and Sent.
634029	3	Grade 3 to Grade 4	275	232	W.1.5.3.F.a	Spell., Cap., Punct.
634162	3	Grade 3 to Grade 4	275	232	W.1.5.3.D	Org and Style
626574	3	Grade 3 to Grade 4	277	232	W.1.5.3.C	Org and Style
636550	3	Grade 3 to Grade 4	276	232	W.1.5.3.F.d	Gram. and Sent.
622979	3	Grade 3 to Grade 4	274	232	W.1.5.3.A	Focus and Content
621008	3	Grade 3 to Grade 4	274	232	W.1.5.3.F.d	Gram. and Sent.
623107	3	Grade 3 to Grade 4	276	232	W.1.5.3.B	Focus and Content
625516	3	Grade 3 to Grade 4	275	232	W.1.5.3.F.c	Spell., Cap., Punct.
623113	4	Grade 3 to Grade 4	274	233	W.1.5.4.C	Org and Style
637175	4	Grade 3 to Grade 4	274	232	W.1.5.4.D	Org and Style
633445	4	Grade 3 to Grade 4	274	235	W.1.5.4.F.a	Spell., Cap., Punct.
635414	4	Grade 3 to Grade 4	274	233	W.1.5.4.A	Focus and Content
639852	4	Grade 3 to Grade 4	274	234	W.1.5.4.F.c	Spell., Cap., Punct.
623033	4	Grade 3 to Grade 4	274	232	W.1.5.4.F.b	Spell., Cap., Punct.
623013	4	Grade 3 to Grade 4	274	233	W.1.5.4.B	Focus and Content
633852	4	Grade 3 to Grade 4	274	233	W.1.5.4.C	Org and Style
624765	4	Grade 3 to Grade 4	274	233	W.1.5.4.F.d	Gram. and Sent.
625527	4	Grade 3 to Grade 4	274	232	W.1.5.4.E	Editing
627004	4	Grade 3 to Grade 4	275	232	W.1.5.4.E	Editing
637177	4	Grade 3 to Grade 4	275	235	W.1.5.4.D	Org and Style
633432	4	Grade 3 to Grade 4	275	233	W.1.5.4.F.a	Spell., Cap., Punct.
633464	4	Grade 3 to Grade 4	275	234	W.1.5.4.A	Focus and Content
639854	4	Grade 3 to Grade 4	275	232	W.1.5.4.F.c	Spell., Cap., Punct.
623136	4	Grade 3 to Grade 4	275	233	W.1.5.4.F.b	Spell., Cap., Punct.
635900	4	Grade 3 to Grade 4	275	233	W.1.5.4.B	Focus and Content
635412	4	Grade 3 to Grade 4	275	233	W.1.5.4.C	Org and Style
630419	4	Grade 3 to Grade 4	275	232	W.1.5.4.F.d	Gram. and Sent.
630295	4	Grade 3 to Grade 4	275	235	W.1.5.4.E	Editing

Table C–47. Writing/English Composition Items Used to Link Grade 4 to Grade 5

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Writing/Composition Diagnostic Category
623017	4	Grade 4 to Grade 5	235	221	W.1.5.4.E	Editing
625455	4	Grade 4 to Grade 5	233	221	W.1.5.4.A	Focus and Content
622453	4	Grade 4 to Grade 5	234	221	W.1.5.4.E	Editing
623135	4	Grade 4 to Grade 5	232	221	W.1.5.4.F.b	Spell., Cap., Punct.
632573	4	Grade 4 to Grade 5	233	221	W.1.5.4.F.d	Gram. and Sent.
623020	4	Grade 4 to Grade 5	233	221	W.1.5.4.C	Org and Style
633435	4	Grade 4 to Grade 5	233	221	W.1.5.4.F.a	Spell., Cap., Punct.
623108	4	Grade 4 to Grade 5	232	221	W.1.5.4.B	Focus and Content
633468	4	Grade 4 to Grade 5	235	221	W.1.5.4.C	Org and Style
627696	4	Grade 4 to Grade 5	233	221	W.1.5.4.F.c	Spell., Cap., Punct.
623115	4	Grade 4 to Grade 5	233	221	W.1.5.4.E	Editing
622983	4	Grade 4 to Grade 5	234	221	W.1.5.4.A	Focus and Content
622454	4	Grade 4 to Grade 5	232	221	W.1.5.4.E	Editing
621395	4	Grade 4 to Grade 5	233	221	W.1.5.4.F.b	Spell., Cap., Punct.
632587	4	Grade 4 to Grade 5	233	221	W.1.5.4.F.d	Gram. and Sent.
623019	4	Grade 4 to Grade 5	233	221	W.1.5.4.C	Org and Style
634025	4	Grade 4 to Grade 5	232	221	W.1.5.4.F.a	Spell., Cap., Punct.
626922	4	Grade 4 to Grade 5	235	221	W.1.5.4.B	Focus and Content
633469	4	Grade 4 to Grade 5	233	221	W.1.5.4.C	Org and Style
628471	4	Grade 4 to Grade 5	234	221	W.1.5.4.F.c	Spell., Cap., Punct.
637149	5	Grade 4 to Grade 5	233	218	W.1.5.5.F.d	Gram. and Sent.
633440	5	Grade 4 to Grade 5	233	221	W.1.5.5.F.a	Spell., Cap., Punct.
635884	5	Grade 4 to Grade 5	233	221	W.1.5.5.E	Editing
637062	5	Grade 4 to Grade 5	233	218	W.1.5.5.F.d	Gram. and Sent.
623027	5	Grade 4 to Grade 5	233	220	W.1.5.5.F.d	Gram. and Sent.
622469	5	Grade 4 to Grade 5	233	221	W.1.5.5.F.b	Spell., Cap., Punct.
639843	5	Grade 4 to Grade 5	233	222	W.1.5.5.F.c	Spell., Cap., Punct.
635417	5	Grade 4 to Grade 5	233	221	W.1.5.5.C	Org and Style
620819	5	Grade 4 to Grade 5	233	220	W.1.5.5.C	Org and Style
635605	5	Grade 4 to Grade 5	233	221	W.1.5.5.C	Org and Style
637148	5	Grade 4 to Grade 5	232	221	W.1.5.5.C	Org and Style
633439	5	Grade 4 to Grade 5	232	221	W.1.5.5.F.a	Spell., Cap., Punct.
620820	5	Grade 4 to Grade 5	232	218	W.1.5.5.E	Editing
626566	5	Grade 4 to Grade 5	232	220	W.1.5.5.F.d	Gram. and Sent.
623129	5	Grade 4 to Grade 5	232	221	W.1.5.5.F.d	Gram. and Sent.
629858	5	Grade 4 to Grade 5	232	222	W.1.5.5.F.b	Spell., Cap., Punct.
639864	5	Grade 4 to Grade 5	232	221	W.1.5.5.F.c	Spell., Cap., Punct.
627291	5	Grade 4 to Grade 5	232	220	W.1.5.5.C	Org and Style
639349	5	Grade 4 to Grade 5	232	218	W.1.5.5.C	Org and Style
626818	5	Grade 4 to Grade 5	232	221	W.1.5.5.C	Org and Style

Table C–48. Writing/English Composition Items Used to Link Grade 5 to Grade 6

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Writing/Composition Diagnostic Category
623105	5	Grade 5 to Grade 6	221	303	W.1.5.5.A	Focus and Content
626927	5	Grade 5 to Grade 6	218	303	W.1.5.5.F.d	Gram. and Sent.
632608	5	Grade 5 to Grade 6	220	303	W.1.5.5.E	Editing
625460	5	Grade 5 to Grade 6	221	303	W.1.5.5.C	Org and Style
626923	5	Grade 5 to Grade 6	222	303	W.1.5.5.E	Editing
628065	5	Grade 5 to Grade 6	221	303	W.1.5.5.F.b	Spell., Cap., Punct.
633443	5	Grade 5 to Grade 6	220	303	W.1.5.5.F.a	Spell., Cap., Punct.
621390	5	Grade 5 to Grade 6	218	303	W.1.5.5.F.c	Spell., Cap., Punct.
626820	5	Grade 5 to Grade 6	221	303	W.1.5.5.E	Editing
624842	5	Grade 5 to Grade 6	218	303	W.1.5.5.F.d	Gram. and Sent.
624800	5	Grade 5 to Grade 6	218	304	W.1.5.5.A	Focus and Content
627413	5	Grade 5 to Grade 6	220	304	W.1.5.5.F.d	Gram. and Sent.
630403	5	Grade 5 to Grade 6	221	304	W.1.5.5.E	Editing
624804	5	Grade 5 to Grade 6	222	304	W.1.5.5.C	Org and Style
626570	5	Grade 5 to Grade 6	221	304	W.1.5.5.E	Editing
624773	5	Grade 5 to Grade 6	220	304	W.1.5.5.F.b	Spell., Cap., Punct.
633442	5	Grade 5 to Grade 6	218	304	W.1.5.5.F.a	Spell., Cap., Punct.
629854	5	Grade 5 to Grade 6	221	304	W.1.5.5.F.c	Spell., Cap., Punct.
623060	5	Grade 5 to Grade 6	221	304	W.1.5.5.E	Editing
627488	5	Grade 5 to Grade 6	220	304	W.1.5.5.F.d	Gram. and Sent.
624292	6	Grade 5 to Grade 6	221	304	W.1.5.6.E	Editing
626934	6	Grade 5 to Grade 6	221	303	W.1.5.6.A	Focus and Content
627013	6	Grade 5 to Grade 6	221	304	W.1.5.6.F.b	Spell., Cap., Punct.
632646	6	Grade 5 to Grade 6	221	305	W.1.5.6.F.d	Gram. and Sent.
624829	6	Grade 5 to Grade 6	221	304	W.1.5.6.F.d	Gram. and Sent.
630378	6	Grade 5 to Grade 6	221	304	W.1.5.6.B	Focus and Content
624297	6	Grade 5 to Grade 6	221	303	W.1.5.6.C	Org and Style
635654	6	Grade 5 to Grade 6	221	304	W.1.5.6.F.c	Spell., Cap., Punct.
639363	6	Grade 5 to Grade 6	221	305	W.1.5.6.C	Org and Style
633448	6	Grade 5 to Grade 6	221	304	W.1.5.6.F.a	Spell., Cap., Punct.
623114	6	Grade 5 to Grade 6	222	303	W.1.5.6.E	Editing
626932	6	Grade 5 to Grade 6	222	304	W.1.5.6.A	Focus and Content
635660	6	Grade 5 to Grade 6	222	305	W.1.5.6.F.b	Spell., Cap., Punct.
626822	6	Grade 5 to Grade 6	222	304	W.1.5.6.F.d	Gram. and Sent.
625478	6	Grade 5 to Grade 6	222	304	W.1.5.6.F.d	Gram. and Sent.
626776	6	Grade 5 to Grade 6	222	303	W.1.5.6.B	Focus and Content
624296	6	Grade 5 to Grade 6	222	304	W.1.5.6.C	Org and Style
628055	6	Grade 5 to Grade 6	222	305	W.1.5.6.F.c	Spell., Cap., Punct.
627289	6	Grade 5 to Grade 6	222	304	W.1.5.6.C	Org and Style
633444	6	Grade 5 to Grade 6	222	304	W.1.5.6.F.a	Spell., Cap., Punct.

Table C–49. Writing/English Composition Items Used to Link Grade 6 to Grade 7

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Writing/Composition Diagnostic Category
633446	6	Grade 6 to Grade 7	304	279	W.1.5.6.F.a	Spell., Cap., Punct.
635619	6	Grade 6 to Grade 7	305	279	W.1.5.6.D	Org and Style
635662	6	Grade 6 to Grade 7	304	279	W.1.5.6.F.b	Spell., Cap., Punct.
623111	6	Grade 6 to Grade 7	304	279	W.1.5.6.E	Editing
624754	6	Grade 6 to Grade 7	303	279	W.1.5.6.F.d	Gram. and Sent.
628060	6	Grade 6 to Grade 7	304	279	W.1.5.6.F.c	Spell., Cap., Punct.
627415	6	Grade 6 to Grade 7	305	279	W.1.5.6.F.d	Gram. and Sent.
624287	6	Grade 6 to Grade 7	304	279	W.1.5.6.E	Editing
624763	6	Grade 6 to Grade 7	304	279	W.1.5.6.F.d	Gram. and Sent.
627960	6	Grade 6 to Grade 7	303	279	W.1.5.6.A	Focus and Content
633447	6	Grade 6 to Grade 7	305	279	W.1.5.6.F.a	Spell., Cap., Punct.
639392	6	Grade 6 to Grade 7	304	279	W.1.5.6.D	Org and Style
635661	6	Grade 6 to Grade 7	304	279	W.1.5.6.F.b	Spell., Cap., Punct.
624289	6	Grade 6 to Grade 7	303	279	W.1.5.6.E	Editing
624756	6	Grade 6 to Grade 7	304	279	W.1.5.6.F.d	Gram. and Sent.
628061	6	Grade 6 to Grade 7	305	279	W.1.5.6.F.c	Spell., Cap., Punct.
628112	6	Grade 6 to Grade 7	304	279	W.1.5.6.F.d	Gram. and Sent.
626567	6	Grade 6 to Grade 7	304	279	W.1.5.6.E	Editing
624840	6	Grade 6 to Grade 7	303	279	W.1.5.6.F.d	Gram. and Sent.
627030	6	Grade 6 to Grade 7	304	279	W.1.5.6.A	Focus and Content
627052	7	Grade 6 to Grade 7	303	280	W.1.5.7.F.d	Gram. and Sent.
639447	7	Grade 6 to Grade 7	303	280	W.1.5.7.F.d	Gram. and Sent.
627058	7	Grade 6 to Grade 7	303	280	W.1.5.7.F.d	Gram. and Sent.
639380	7	Grade 6 to Grade 7	303	279	W.1.5.7.A	Focus and Content
624286	7	Grade 6 to Grade 7	303	280	W.1.5.7.B	Focus and Content
624822	7	Grade 6 to Grade 7	303	280	W.1.5.7.F.b	Spell., Cap., Punct.
636003	7	Grade 6 to Grade 7	303	280	W.1.5.7.C	Org and Style
633454	7	Grade 6 to Grade 7	303	280	W.1.5.7.F.a	Spell., Cap., Punct.
635909	7	Grade 6 to Grade 7	303	279	W.1.5.7.D	Org and Style
634300	7	Grade 6 to Grade 7	303	280	W.1.5.7.F.c	Spell., Cap., Punct.
626992	7	Grade 6 to Grade 7	303	280	W.1.5.7.F.d	Gram. and Sent.
639438	7	Grade 6 to Grade 7	303	280	W.1.5.7.F.d	Gram. and Sent.
628116	7	Grade 6 to Grade 7	303	279	W.1.5.7.F.d	Gram. and Sent.
626764	7	Grade 6 to Grade 7	303	280	W.1.5.7.A	Focus and Content
639394	7	Grade 6 to Grade 7	303	280	W.1.5.7.B	Focus and Content
628476	7	Grade 6 to Grade 7	303	280	W.1.5.7.F.b	Spell., Cap., Punct.
636008	7	Grade 6 to Grade 7	303	280	W.1.5.7.C	Org and Style
633455	7	Grade 6 to Grade 7	303	279	W.1.5.7.F.a	Spell., Cap., Punct.
639420	7	Grade 6 to Grade 7	303	280	W.1.5.7.D	Org and Style
634299	7	Grade 6 to Grade 7	303	280	W.1.5.7.F.c	Spell., Cap., Punct.

Table C–50. Writing/English Composition Items Used to Link Grade 7 to Grade 8

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Writing/Composition Diagnostic Category
627684	7	Grade 8 to Grade 7	280	145	W.1.5.7.F.d	Gram. and Sent.
625487	7	Grade 8 to Grade 7	279	145	W.1.5.7.F.d	Gram. and Sent.
627464	7	Grade 8 to Grade 7	280	145	W.1.5.7.A	Focus and Content
639375	7	Grade 8 to Grade 7	280	145	W.1.5.7.C	Org and Style
633458	7	Grade 8 to Grade 7	280	145	W.1.5.7.F.a	Spell., Cap., Punct.
626996	7	Grade 8 to Grade 7	280	145	W.1.5.7.E	Editing
628098	7	Grade 8 to Grade 7	279	145	W.1.5.7.F.b	Spell., Cap., Punct.
639358	7	Grade 8 to Grade 7	280	145	W.1.5.7.B	Focus and Content
635665	7	Grade 8 to Grade 7	280	145	W.1.5.7.F.c	Spell., Cap., Punct.
627361	7	Grade 8 to Grade 7	280	145	W.1.5.7.C	Org and Style
627056	7	Grade 8 to Grade 7	279	145	W.1.5.7.F.d	Gram. and Sent.
639407	7	Grade 8 to Grade 7	280	145	W.1.5.7.F.d	Gram. and Sent.
626943	7	Grade 8 to Grade 7	280	145	W.1.5.7.A	Focus and Content
639364	7	Grade 8 to Grade 7	280	145	W.1.5.7.C	Org and Style
633457	7	Grade 8 to Grade 7	280	145	W.1.5.7.F.a	Spell., Cap., Punct.
626997	7	Grade 8 to Grade 7	279	145	W.1.5.7.F.d	Gram. and Sent.
630429	7	Grade 8 to Grade 7	280	145	W.1.5.7.F.b	Spell., Cap., Punct.
625506	7	Grade 8 to Grade 7	280	145	W.1.5.7.B	Focus and Content
635668	7	Grade 8 to Grade 7	280	145	W.1.5.7.F.c	Spell., Cap., Punct.
627362	7	Grade 8 to Grade 7	280	145	W.1.5.7.C	Org and Style
633498	8	Grade 8 to Grade 7	279	144	W.1.5.8.F.a	Spell., Cap., Punct.
639580	8	Grade 8 to Grade 7	279	145	W.1.5.8.C	Org and Style
624848	8	Grade 8 to Grade 7	279	143	W.1.5.8.F.b	Spell., Cap., Punct.
639612	8	Grade 8 to Grade 7	279	144	W.1.5.8.B	Focus and Content
628115	8	Grade 8 to Grade 7	279	144	W.1.5.8.F.d	Gram. and Sent.
627963	8	Grade 8 to Grade 7	279	144	W.1.5.8.A	Focus and Content
628311	8	Grade 8 to Grade 7	279	145	W.1.5.8.F.d	Gram. and Sent.
628242	8	Grade 8 to Grade 7	279	143	W.1.5.8.B	Focus and Content
639857	8	Grade 8 to Grade 7	279	144	W.1.5.8.F.c	Spell., Cap., Punct.
639441	8	Grade 8 to Grade 7	279	144	W.1.5.8.F.d	Gram. and Sent.
633497	8	Grade 8 to Grade 7	280	145	W.1.5.8.F.a	Spell., Cap., Punct.
639588	8	Grade 8 to Grade 7	280	143	W.1.5.8.C	Org and Style
625522	8	Grade 8 to Grade 7	280	144	W.1.5.8.F.b	Spell., Cap., Punct.
639610	8	Grade 8 to Grade 7	280	144	W.1.5.8.B	Focus and Content
624828	8	Grade 8 to Grade 7	280	144	W.1.5.8.F.d	Gram. and Sent.
625520	8	Grade 8 to Grade 7	280	145	W.1.5.8.A	Focus and Content
625508	8	Grade 8 to Grade 7	280	143	W.1.5.8.F.d	Gram. and Sent.
626775	8	Grade 8 to Grade 7	280	144	W.1.5.8.B	Focus and Content
639856	8	Grade 8 to Grade 7	280	144	W.1.5.8.F.c	Spell., Cap., Punct.
639439	8	Grade 8 to Grade 7	280	144	W.1.5.8.F.d	Gram. and Sent.

Table C–51. Writing/English Composition Items Used to Link English Composition to Grade 8

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Writing/Composition Diagnostic Category
636213	8	English Comp to Grade 8	143	173	W.1.5.8.F.d	Gram. and Sent.
639599	8	English Comp to Grade 8	144	173	W.1.5.8.C	Org and Style
633503	8	English Comp to Grade 8	144	173	W.1.5.8.F.a	Spell., Cap., Punct.
629857	8	English Comp to Grade 8	144	173	W.1.5.8.F.b	Spell., Cap., Punct.
634156	8	English Comp to Grade 8	145	173	W.1.5.8.F.c	Spell., Cap., Punct.
639577	8	English Comp to Grade 8	143	173	W.1.5.8.E	Editing
635385	8	English Comp to Grade 8	144	173	W.1.5.8.F.d	Gram. and Sent.
635351	8	English Comp to Grade 8	144	173	W.1.5.8.F.d	Gram. and Sent.
627964	8	English Comp to Grade 8	144	173	W.1.5.8.A	Focus and Content
626786	8	English Comp to Grade 8	145	173	W.1.5.8.C	Org and Style
636212	8	English Comp to Grade 8	144	171	W.1.5.8.F.d	Gram. and Sent.
639597	8	English Comp to Grade 8	144	171	W.1.5.8.C	Org and Style
633502	8	English Comp to Grade 8	144	171	W.1.5.8.F.a	Spell., Cap., Punct.
629860	8	English Comp to Grade 8	145	171	W.1.5.8.F.b	Spell., Cap., Punct.
634157	8	English Comp to Grade 8	143	171	W.1.5.8.F.c	Spell., Cap., Punct.
639608	8	English Comp to Grade 8	144	171	W.1.5.8.E	Editing
635386	8	English Comp to Grade 8	144	171	W.1.5.8.F.d	Gram. and Sent.
635350	8	English Comp to Grade 8	144	171	W.1.5.8.F.d	Gram. and Sent.
628143	8	English Comp to Grade 8	145	171	W.1.5.8.A	Focus and Content
626785	8	English Comp to Grade 8	143	171	W.1.5.8.C	Org and Style
622816	EC	English Comp to Grade 8	143	173	C.E.1.1.1	Focus and Content
639932	EC	English Comp to Grade 8	143	173	C.E.3.1.5	Gram. and Sent.
639920	EC	English Comp to Grade 8	143	171	C.E.3.1.4	Gram. and Sent.
634313	EC	English Comp to Grade 8	143	173	C.E.3.1.2	Spell., Cap., Punct.
633540	EC	English Comp to Grade 8	143	172	C.E.3.1.1	Spell., Cap., Punct.
622613	EC	English Comp to Grade 8	143	173	C.E.1.1.3	Org and Style
623126	EC	English Comp to Grade 8	143	173	C.E.3.1.4	Gram. and Sent.
639971	EC	English Comp to Grade 8	143	174	C.E.1.1.2	Focus and Content
629853	EC	English Comp to Grade 8	143	174	C.E.3.1.3	Spell., Cap., Punct.
630391	EC	English Comp to Grade 8	143	173	C.E.1.1.3	Org and Style
622815	EC	English Comp to Grade 8	145	174	C.P.1.1.1	Focus and Content
639933	EC	English Comp to Grade 8	145	173	C.E.3.1.5	Gram. and Sent.
639919	EC	English Comp to Grade 8	145	173	C.E.3.1.4	Gram. and Sent.
634349	EC	English Comp to Grade 8	145	174	C.E.3.1.2	Spell., Cap., Punct.
633536	EC	English Comp to Grade 8	145	174	C.E.3.1.1	Spell., Cap., Punct.
622611	EC	English Comp to Grade 8	145	174	C.E.1.1.3	Org and Style
621166	EC	English Comp to Grade 8	145	173	C.E.3.1.4	Gram. and Sent.
630659	EC	English Comp to Grade 8	145	173	C.E.1.1.2	Focus and Content
629822	EC	English Comp to Grade 8	145	173	C.E.3.1.3	Spell., Cap., Punct.
630392	EC	English Comp to Grade 8	145	171	C.E.1.1.3	Org and Style

Tables C–52 through C–57 summarize the number of linking items by diagnostic category.

Table C–52. Number of Items Linking Grade 3 to Grade 4 by Diagnostic Category

Diagnostic Category	Grade 3 Items	Grade 4 Items	Total
Focus and Content	4	4	8
Org and Style	4	5	9
Editing	0	3	3
Spell., Cap., Punct.	6	6	12
Gram. and Sent.	6	2	8
TOTAL	20	20	40

Table C–53. Number of Items Linking Grade 4 to Grade 5 by Diagnostic Category

Diagnostic Category	Grade 4 Items	Grade 5 Items	Total
Focus and Content	4	0	4
Org and Style	4	7	11
Editing	4	2	6
Spell., Cap., Punct.	6	6	12
Gram. and Sent.	2	5	7
TOTAL	20	20	40

Table C–54. Number of Items Linking Grade 5 to Grade 6 by Diagnostic Category

Diagnostic Category	Grade 5 Items	Grade 6 Items	Total
Focus and Content	2	4	6
Org and Style	2	4	6
Editing	6	2	8
Spell., Cap., Punct.	6	6	12
Gram. and Sent.	4	4	8
TOTAL	20	20	40

Table C–55. Number of Items Linking Grade 6 to Grade 7 by Diagnostic Category

Diagnostic Category	Grade 6 Items	Grade 7 Items	Total
Focus and Content	2	4	6
Org and Style	2	4	6
Editing	4	0	4
Spell., Cap., Punct.	6	6	12
Gram. and Sent.	6	6	12
TOTAL	20	20	40

Table C–56. Number of Items Linking Grade 8 to Grade 7 by Diagnostic Category

Diagnostic Category	Grade 7 Items	Grade 8 Items	Total
Focus and Content	4	6	10
Org and Style	4	2	6
Editing	1	0	1
Spell., Cap., Punct.	6	6	12
Gram. and Sent.	5	6	11
TOTAL	20	20	40

Table C–57. Number of Items Linking English Composition to Grade 8 by Diagnostic Category

Diagnostic Category	Grade 8 Items	Eng Comp Items	Total
Focus and Content	2	4	6
Org and Style	4	4	8
Editing	2	0	2
Spell., Cap., Punct.	6	6	12
Gram. and Sent.	6	6	12
TOTAL	20	20	40

Table C–58. Writing/English Composition Example of Vertical Linking Workbook

		Grade 4 Calibration			Grade 5 Calibration				Grade 4 on		
Item ID	Item Grade	Difficulty	Fit	Displace	Difficulty	Fit	Displace	Discrepancy	Grade 5 Scale	Robust Z	Flag
623017	4	-0.784	0.910	-0.006	-0.927	0.910	0.000	-0.143	-1.005	0.233	
625455	4	-0.205	1.030	-0.001	0.132	1.010	0.001	0.337	-0.426	1.437	
622453	4	-0.955	0.910	0.003	-1.526	0.860	0.000	-0.571	-1.176	-0.840	
623135	4	1.520	1.200	0.005	1.516	1.110	0.001	-0.004	1.299	0.582	
632573	4	0.527	1.250	-0.002	0.872	1.190	0.001	0.345	0.306	1.457	
623020	4	-1.254	0.890	-0.001	-1.487	0.900	0.000	-0.233	-1.475	0.008	
633435	4	-0.452	1.020	-0.003	-0.441	0.910	0.000	0.011	-0.673	0.620	
623108	4	-0.152	0.830	0.000	0.025	0.920	0.000	0.177	-0.373	1.036	
633468	4	-0.857	0.900	-0.006	-0.475	0.860	0.000	0.382	-1.078	1.550	
627696	4	1.837	1.210	-0.001	1.968	1.140	0.001	0.131	1.616	0.921	
623115	4	-0.678	0.960	-0.001	-1.072	0.890	-0.003	-0.394	-0.899	-0.396	
622983	4	-0.797	1.020	0.003	-1.360	0.980	-0.003	-0.563	-1.018	-0.820	
622454	4	0.922	1.070	0.005	0.483	1.000	-0.002	-0.439	0.701	-0.509	
621395	4	1.634	1.080	-0.002	0.998	1.090	-0.002	-0.636	1.413	-1.003	
632587	4	0.650	0.830	-0.001	0.149	0.980	-0.002	-0.501	0.429	-0.665	
623019	4	-1.134	0.990	-0.003	-1.611	1.020	-0.003	-0.477	-1.355	-0.605	
634025	4	-0.885	0.960	0.000	-1.496	0.920	-0.003	-0.611	-1.106	-0.941	
626922	4	0.516	1.000	-0.006	0.159	0.970	-0.002	-0.357	0.295	-0.304	
633469	4	-0.151	0.880	-0.001	-0.121	0.900	-0.002	0.030	-0.372	0.667	
628471	4	2.662	1.140	0.003	2.119	1.130	-0.001	-0.543	2.441	-0.770	
637149	5	-2.406	0.960	0.003	-2.126	0.960	0.005	0.280	-2.627	1.294	
633440	5	-0.302	1.040	0.003	-0.227	0.960	0.001	0.075	-0.523	0.780	
635884	5	-1.607	0.840	0.003	-1.708	0.870	-0.001	-0.101	-1.828	0.339	
637062	5	0.739	1.110	0.004	0.794	1.170	0.000	0.055	0.518	0.730	
623027	5	-0.341	0.780	0.003	-0.917	0.800	-0.004	-0.576	-0.562	-0.853	
622469	5	1.057	1.110	0.004	0.730	1.000	0.000	-0.327	0.836	-0.228	
639843	5	-0.548	0.910	0.003	-1.127	0.990	-0.002	-0.579	-0.769	-0.860	
635417	5	0.499	1.050	0.004	0.561	1.050	-0.005	0.062	0.278	0.747	
620819	5	0.739	0.970	0.004	0.337	0.950	-0.005	-0.402	0.518	-0.416	
635605	5	1.417	1.220	0.004	1.437	1.080	0.001	0.020	1.196	0.642	
637148	5	-0.606	0.950	0.002	-1.440	0.920	0.001	-0.834	-0.827	-1.500	
633439	5	0.404	1.100	0.002	0.544	1.050	-0.001	0.140	0.183	0.943	
620820	5	0.287	0.950	0.002	0.089	0.960	0.000	-0.198	0.066	0.095	
626566	5	-0.764	0.860	0.002	-1.003	0.860	-0.004	-0.239	-0.985	-0.008	
623129	5	-1.331	0.800	0.002	-1.323	0.820	0.000	0.008	-1.552	0.612	
629858	5	1.124	1.020	0.003	0.983	1.020	-0.002	-0.141	0.903	0.238	
639864	5	-0.729	0.950	0.002	-1.075	0.900	-0.005	-0.346	-0.950	-0.276	
627291	5	0.515	0.880	0.002	0.008	0.970	-0.005	-0.507	0.294	-0.680	
639349	5	0.658	1.040	0.002	0.285	0.890	0.005	-0.373	0.437	-0.344	
626818	5	1.722	0.970	0.003	0.913	0.990	-0.001	-0.809	1.501	-1.437	
	Mean	0.062			-0.159			-0.221	-0.159	0.037	
	SD	1.088			1.095			0.330	1.088	0.828	
	SD Ratio	0.993									
	Correlation	0.954									
	Add. Constant	-0.221									
	Median							-0.236			
	Q							0.539			

Figures C–22 through C–27 are the adjacent grade linking plots. No items were removed from final linking procedure so there are no red items in these plots.

Figure C–22. CDT Writing/English Composition: Grade 3 to Grade 4 Linking – All Links

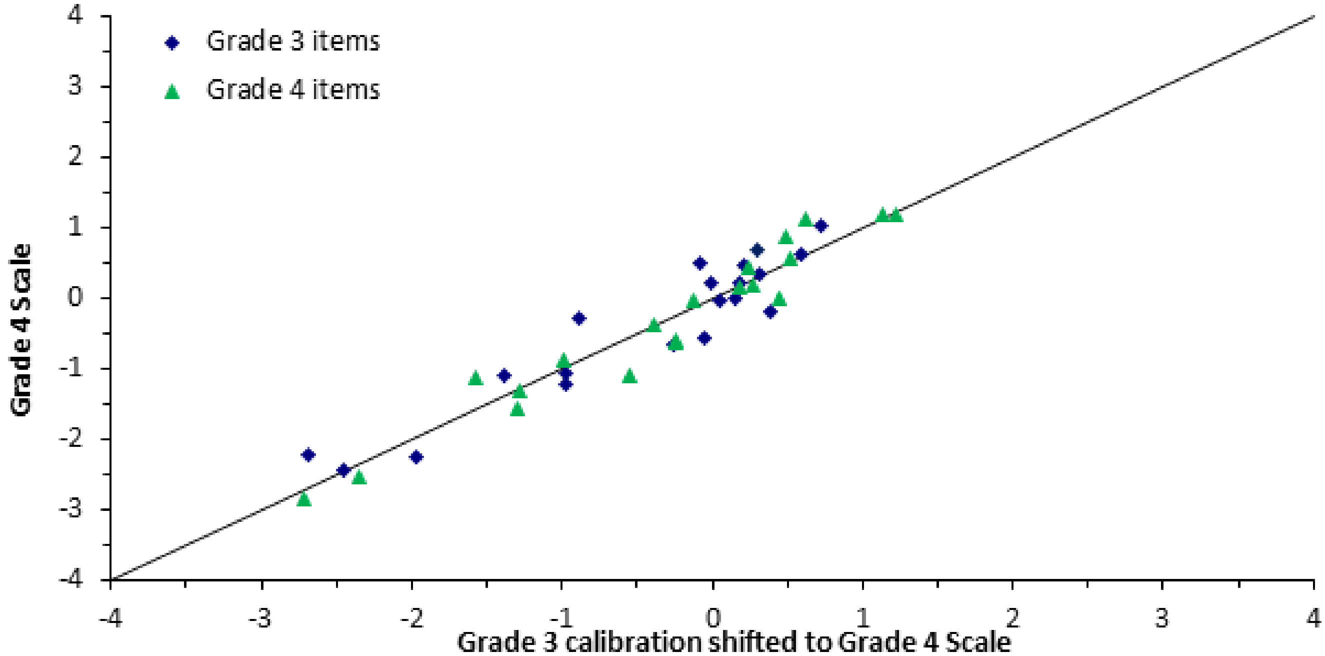


Figure C–23. CDT Writing/English Composition: Grade 4 to Grade 5 Linking – All Links

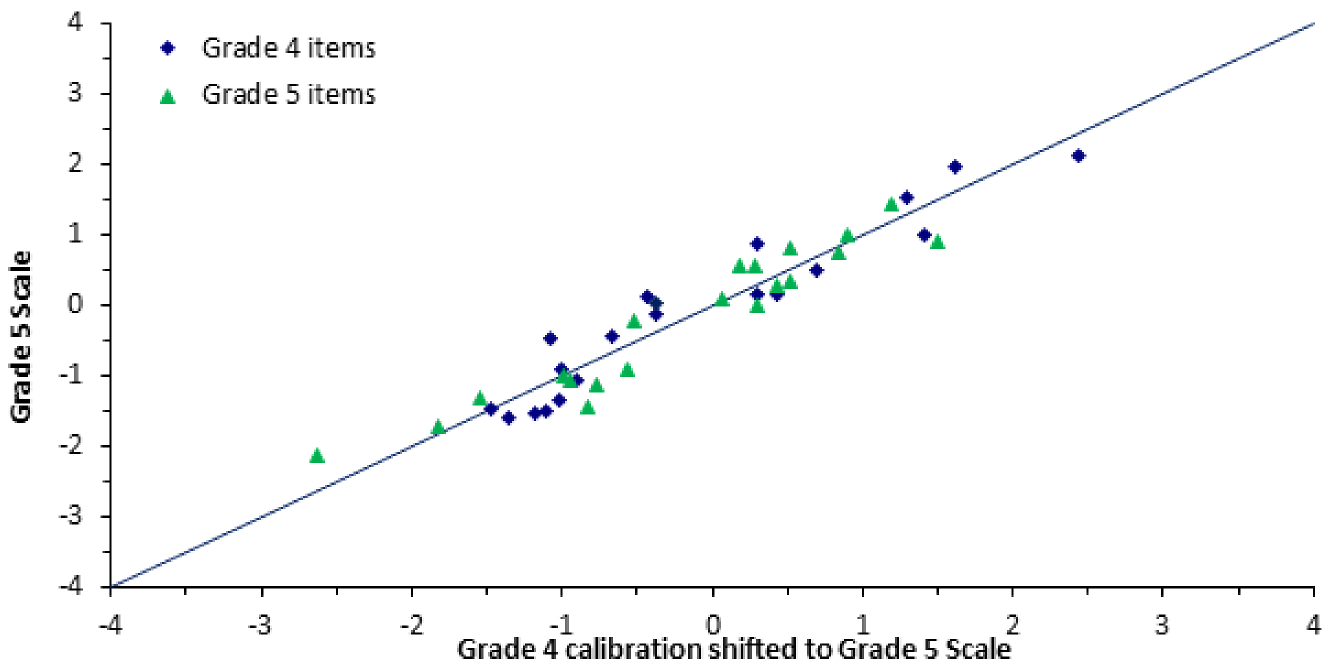


Figure C–24. CDT Writing/English Composition: Grade 5 to Grade 6 Linking – All Links

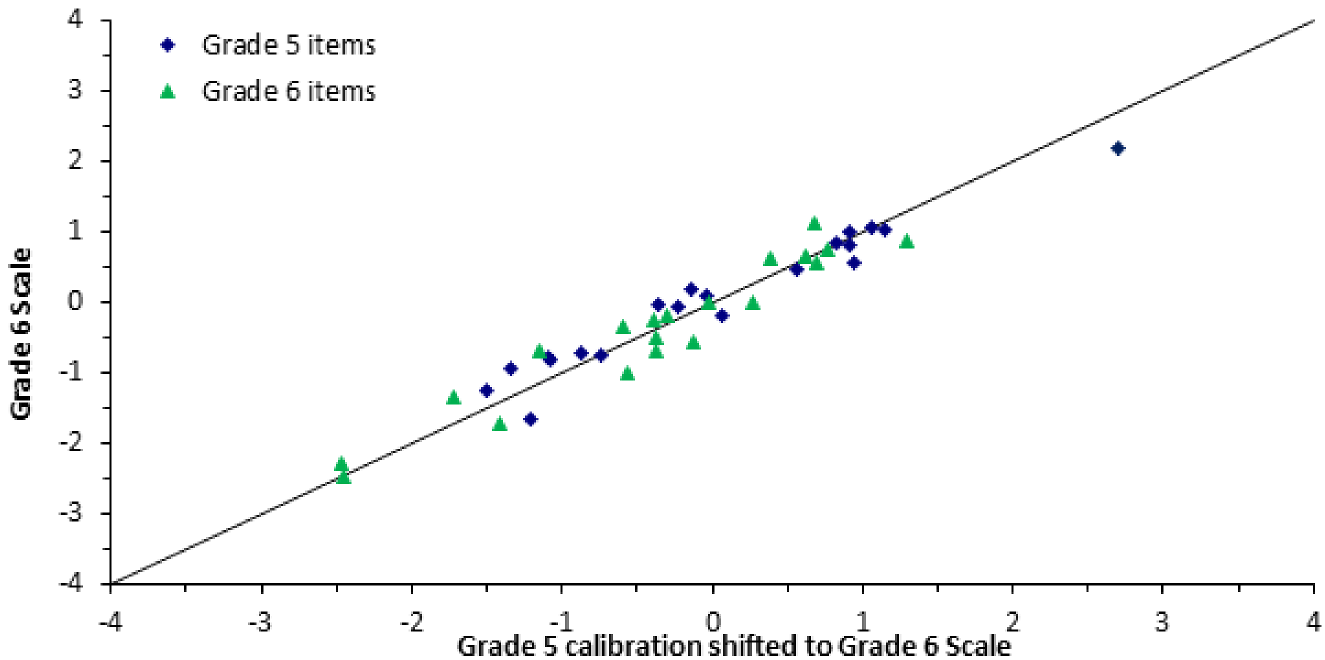


Figure C–25. CDT Writing/English Composition: Grade 6 to Grade 7 Linking – All Links

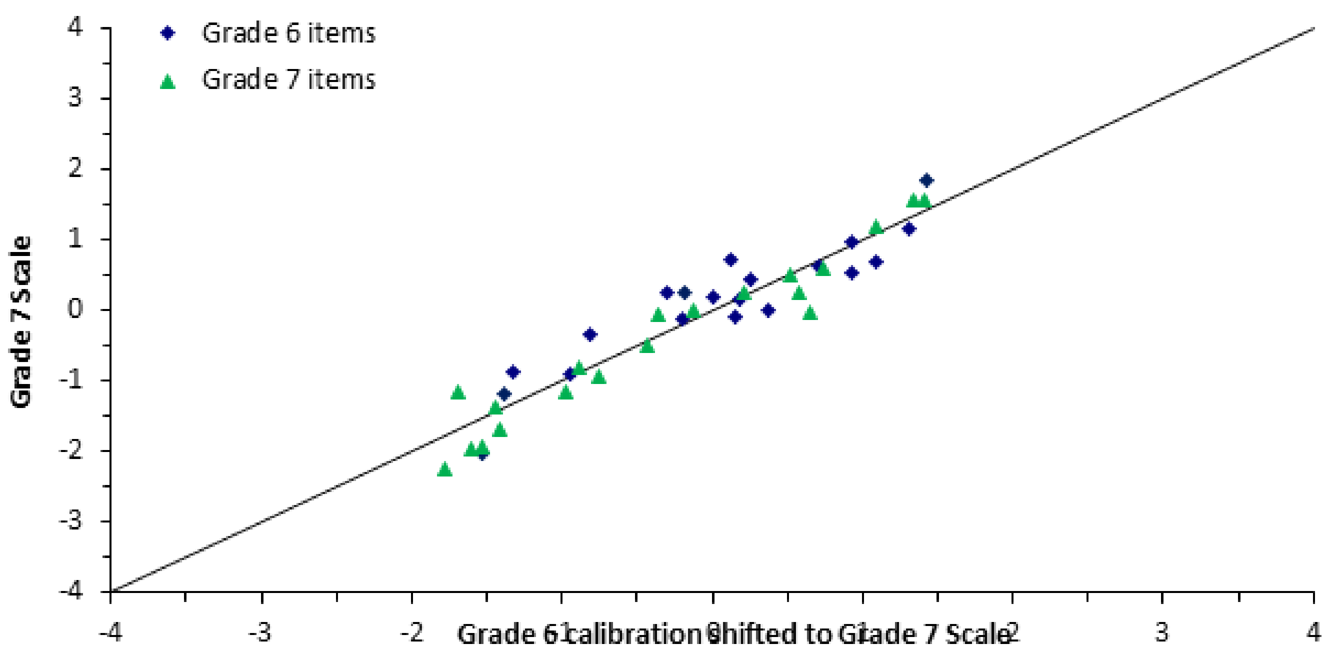


Figure C–26. CDT Writing/English Composition: Grade 8 to Grade 7 Linking – All Links

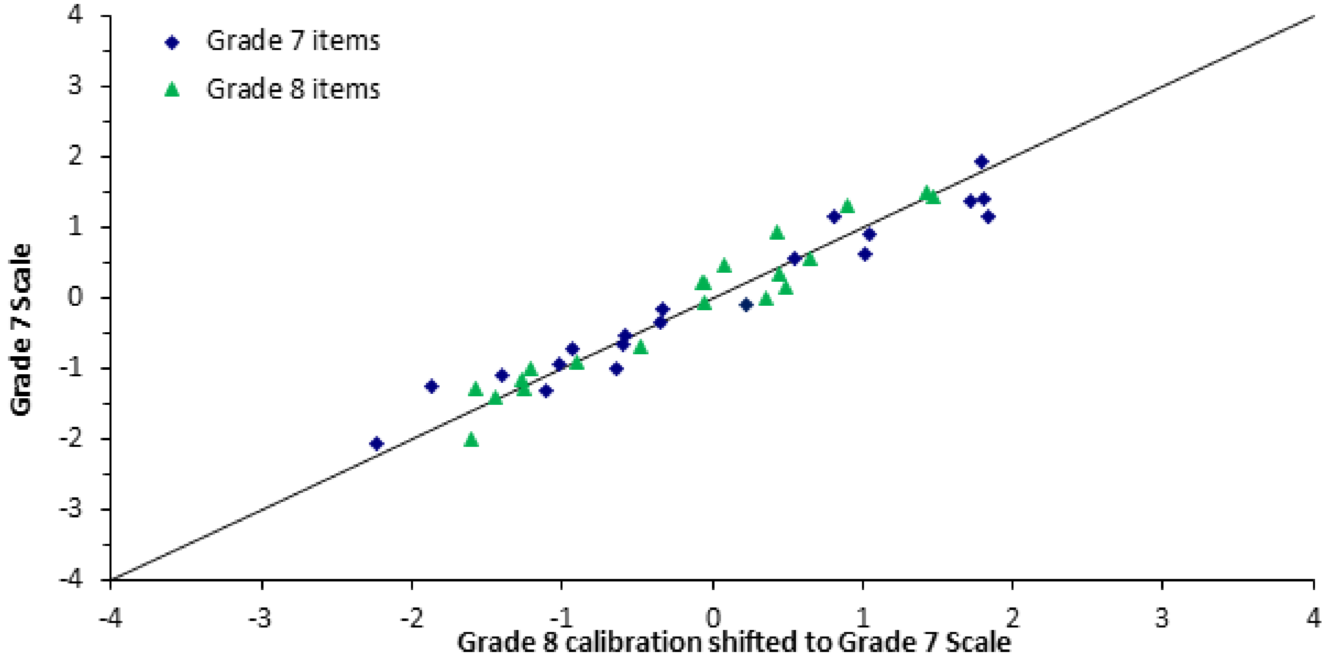
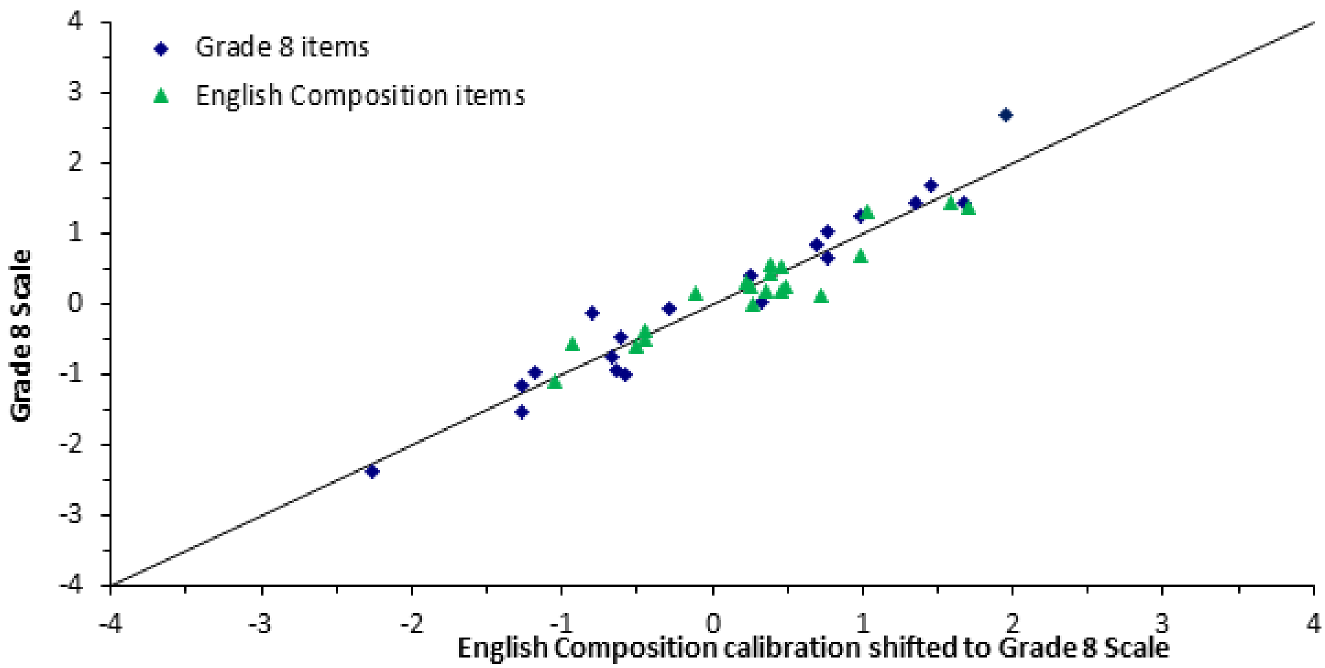


Figure C–27. CDT Writing/English Composition: Literature to Grade 8 Linking – All Links



APPENDIX D: SIGNIFICANT DIFFERENCES AMONG DIAGNOSTIC CATEGORIES

In Chapter Fifteen (Operational Administration 2021–2022), significant differences among diagnostic categories were tested with a t-test using a Bonferroni correction for multiple comparisons to keep the familywise Type I error rate at 0.32. The tables in this appendix show the significant differences with the familywise Type I error rate at 0.10.

DIAGNOSTIC CATEGORY SIGNIFICANT DIFFERENCES

Table D–1a. Diagnostic Category Significant Differences – Math Grades 3–5

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	561	106,414	0.5%	99.5%
DC1	DC3	1,167	105,808	1.1%	98.9%
DC1	DC4	661	106,314	0.6%	99.4%
DC2	DC3	1,246	105,729	1.2%	98.8%
DC2	DC4	589	106,386	0.6%	99.4%
DC3	DC4	1,077	105,898	1.0%	99.0%

Note: Z value is 2.39

Table D–1b. Total Number of Diagnostic Category Significant Differences – Math Grades 3–5

Number of Significant Differences	Number of Students	Percent of Students
0	102,980	96.3%
1	2,954	2.8%
2	779	0.7%
3	259	0.2%
4	3	0.0%
5	0	0.0%
6	0	0.0%

Table D–2a. Diagnostic Category Significant Differences – Math Grades 6–HS

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	1,665	146,526	1.1%	98.9%
DC1	DC3	2,011	146,180	1.4%	98.6%
DC1	DC4	1,948	146,243	1.3%	98.7%
DC2	DC3	1,730	146,461	1.2%	98.8%
DC2	DC4	1,764	146,427	1.2%	98.8%
DC3	DC4	1,891	146,300	1.3%	98.7%

Note: Z value is 2.39

Table D–2b. Total Number of Diagnostic Category Significant Differences – Math Grades 6–HS

Number of Significant Differences	Number of Students	Percent of Students
0	140,262	94.6%
1	5,486	3.7%
2	1,837	1.2%
3	575	0.4%
4	31	0.0%
5	0	0.0%
6	0	0.0%

Table D–3a. Diagnostic Category Significant Differences – Algebra I

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	2,010	74,948	2.6%	97.4%
DC1	DC3	1,780	75,178	2.3%	97.7%
DC1	DC4	2,155	74,803	2.8%	97.2%
DC2	DC3	553	76,405	0.7%	99.3%
DC2	DC4	1,096	75,862	1.4%	98.6%
DC3	DC4	1,072	75,886	1.4%	98.6%

Note: Z value is 2.39

Table D–3b. Total Number of Diagnostic Category Significant Differences – Algebra I

Number of Significant Differences	Number of Students	Percent of Students
0	70,694	91.9%
1	4,316	5.6%
2	1,517	2.0%
3	408	0.5%
4	23	0.0%
5	0	0.0%
6	0	0.0%

Table D–4a. Diagnostic Category Significant Differences – Geometry

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	137	8,458	1.6%	98.4%
DC1	DC3	151	8,444	1.8%	98.2%
DC1	DC4	155	8,440	1.8%	98.2%
DC2	DC3	158	8,437	1.8%	98.2%
DC2	DC4	151	8,444	1.8%	98.2%
DC3	DC4	188	8,407	2.2%	97.8%

Note: Z value is 2.39

Table D–4b. Total Number of Diagnostic Category Significant Differences – Geometry

Number of Significant Differences	Number of Students	Percent of Students
0	7,950	92.5%
1	419	4.9%
2	165	1.9%
3	53	0.6%
4	8	0.1%
5	0	0.0%
6	0	0.0%

Table D–5a. Diagnostic Category Significant Differences – Algebra II

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	290	8,009	3.5%	96.5%
DC1	DC3	212	8,087	2.6%	97.4%
DC1	DC4	490	7,809	5.9%	94.1%
DC2	DC3	110	8,189	1.3%	98.7%
DC2	DC4	191	8,108	2.3%	97.7%
DC3	DC4	168	8,131	2.0%	98.0%

Note: Z value is 2.39

Table D–5b. Total Number of Diagnostic Category Significant Differences – Algebra II

Number of Significant Differences	Number of Students	Percent of Students
0	7,295	87.9%
1	649	7.8%
2	258	3.1%
3	92	1.1%
4	5	0.1%
5	0	0.0%
6	0	0.0%

Table D–6a. Diagnostic Category Significant Differences – Reading Grades 3–5

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	11	100,455	0.0%	100.0%
DC1	DC3	15	100,451	0.0%	100.0%
DC1	DC4	26	100,440	0.0%	100.0%
DC1	DC5	14	100,452	0.0%	100.0%
DC2	DC3	20	100,446	0.0%	100.0%
DC2	DC4	21	100,445	0.0%	100.0%
DC2	DC5	15	100,451	0.0%	100.0%
DC3	DC4	8	100,458	0.0%	100.0%
DC3	DC5	36	100,430	0.0%	100.0%
DC4	DC5	17	100,449	0.0%	100.0%

Note: Z value is 2.58

Table D–6b. Total Number of Diagnostic Category Significant Differences – Reading Grades 3–5

Number of Significant Differences	Number of Students	Percent of Students
0	100,298	99.8%
1	154	0.2%
2	13	0.0%
3	1	0.0%
4	0	0.0%
5	0	0.0%
6	0	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

Table D–7a. Diagnostic Category Significant Differences – Reading/Lit Grades 6–HS

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	43	225,754	0.0%	100.0%
DC1	DC3	23	225,774	0.0%	100.0%
DC1	DC4	25	225,772	0.0%	100.0%
DC1	DC5	87	225,710	0.0%	100.0%
DC2	DC3	35	225,762	0.0%	100.0%
DC2	DC4	34	225,763	0.0%	100.0%
DC2	DC5	123	225,674	0.1%	99.9%
DC3	DC4	30	225,767	0.0%	100.0%
DC3	DC5	185	225,612	0.1%	99.9%
DC4	DC5	83	225,714	0.0%	100.0%

Note: Z value is 2.58

Table D–7b. Total Number of Diagnostic Category Significant Differences – Reading/Lit Grades 6–HS

Number of Significant Differences	Number of Students	Percent of Students
0	225,198	99.7%
1	538	0.2%
2	53	0.0%
3	8	0.0%
4	0	0.0%
5	0	0.0%
6	0	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

Table D–8a. Diagnostic Category Significant Differences – Science Grades 3–5

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	111	30,912	0.4%	99.6%
DC1	DC3	105	30,918	0.3%	99.7%
DC1	DC4	121	30,902	0.4%	99.6%
DC2	DC3	125	30,898	0.4%	99.6%
DC2	DC4	129	30,894	0.4%	99.6%
DC3	DC4	143	30,880	0.5%	99.5%

Note: Z value is 2.39

Table D–8b. Total Number of Diagnostic Category Significant Differences – Science Grades 3–5

Number of Significant Differences	Number of Students	Percent of Students
0	30,485	98.3%
1	381	1.2%
2	118	0.4%
3	39	0.1%
4	0	0.0%
5	0	0.0%
6	0	0.0%

Table D–9a. Diagnostic Category Significant Differences – Science Grades 6–HS

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	736	94,023	0.8%	99.2%
DC1	DC3	764	93,995	0.8%	99.2%
DC1	DC4	715	94,044	0.8%	99.2%
DC2	DC3	747	94,012	0.8%	99.2%
DC2	DC4	642	94,117	0.7%	99.3%
DC3	DC4	585	94,174	0.6%	99.4%

Note: Z value is 2.39

Table D–9b. Total Number of Diagnostic Category Significant Differences – Science Grades 6–HS

Number of Significant Differences	Number of Students	Percent of Students
0	91,720	96.8%
1	2,132	2.2%
2	669	0.7%
3	233	0.2%
4	5	0.0%
5	0	0.0%
6	0	0.0%

Table D–10a. Diagnostic Category Significant Differences – Biology

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	609	86,876	0.7%	99.3%
DC1	DC3	601	86,884	0.7%	99.3%
DC1	DC4	742	86,743	0.8%	99.2%
DC2	DC3	358	87,127	0.4%	99.6%
DC2	DC4	761	86,724	0.9%	99.1%
DC3	DC4	735	86,750	0.8%	99.2%

Note: Z value is 2.39

Table D–10b. Total Number of Diagnostic Category Significant Differences – Biology

Number of Significant Differences	Number of Students	Percent of Students
0	84,548	96.6%
1	2,199	2.5%
2	615	0.7%
3	115	0.1%
4	8	0.0%
5	0	0.0%
6	0	0.0%

Table D–11a. Diagnostic Category Significant Differences – Chemistry

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	264	6,038	4.2%	95.8%
DC1	DC3	181	6,121	2.9%	97.1%
DC1	DC4	163	6,139	2.6%	97.4%
DC2	DC3	7	6,295	0.1%	99.9%
DC2	DC4	21	6,281	0.3%	99.7%
DC3	DC4	21	6,281	0.3%	99.7%

Note: Z value is 2.39

Table D–11b. Total Number of Diagnostic Category Significant Differences – Chemistry

Number of Significant Differences	Number of Students	Percent of Students
0	5,817	92.3%
1	334	5.3%
2	130	2.1%
3	21	0.3%
4	0	0.0%
5	0	0.0%
6	0	0.0%

Table D–12a. Diagnostic Category Significant Differences – Writing Grades 3–5

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	17	13,678	0.1%	99.9%
DC1	DC3	16	13,679	0.1%	99.9%
DC1	DC4	28	13,667	0.2%	99.8%
DC1	DC5	31	13,664	0.2%	99.8%
DC2	DC3	13	13,682	0.1%	99.9%
DC2	DC4	24	13,671	0.2%	99.8%
DC2	DC5	19	13,676	0.1%	99.9%
DC3	DC4	17	13,678	0.1%	99.9%
DC3	DC5	14	13,681	0.1%	99.9%
DC4	DC5	20	13,675	0.1%	99.9%

Note: Z value is 2.58

Table D–12b. Total Number of Diagnostic Category Significant Differences – Writing Grades 3–5

Number of Significant Differences	Number of Students	Percent of Students
0	13,560	99.0%
1	92	0.7%
2	27	0.2%
3	11	0.1%
4	5	0.0%
5	0	0.0%
6	0	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

Table D–13a. Diagnostic Category Significant Differences – Writing/Eng Comp Grades 6–HS

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	73	38,426	0.2%	99.8%
DC1	DC3	104	38,395	0.3%	99.7%
DC1	DC4	143	38,356	0.4%	99.6%
DC1	DC5	133	38,366	0.3%	99.7%
DC2	DC3	81	38,418	0.2%	99.8%
DC2	DC4	89	38,410	0.2%	99.8%
DC2	DC5	107	38,392	0.3%	99.7%
DC3	DC4	105	38,394	0.3%	99.7%
DC3	DC5	110	38,389	0.3%	99.7%
DC4	DC5	106	38,393	0.3%	99.7%

Note: Z value is 2.58

Table D–13b. Total Number of Diagnostic Category Significant Differences – Writing/Eng Comp Grades 6–HS

Number of Significant Differences	Number of Students	Percent of Students
0	37,743	98.0%
1	544	1.4%
2	145	0.4%
3	54	0.1%
4	11	0.0%
5	1	0.0%
6	1	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

APPENDIX E: DECISION CONSISTENCY

In Chapter Sixteen (Reliability), decision consistency for each CDT test and benchmark cut is reported with two values: exact agreement rate and kappa. However, as noted in the chapter, retest classification probability varies at different points along the scale. For example, the retest probability of green is higher for scores near the red/green cut than for scores very low in the red range. This appendix provides a more detailed examination of the differences in retest probability across the score range. 3 X 3 retest classification probability tables and retest classification percent tables by score range are presented for all CDT tests and benchmark cuts.

3 X 3 RETEST CLASSIFICATION PROBABILITY

Table E–1. Retest Classification Probability – Mathematics Grade 3

	Red - retest	Green - retest	Blue - retest
Red – test	0.955	0.045	0.000
Green – test	0.141	0.810	0.049
Blue – test	0.000	0.176	0.824

Exact Agreement Rate = 0.923
Kappa = 0.789
N-count = 32,556

Table E–2. Retest Classification Probability – Mathematics Grade 4

	Red - retest	Green - retest	Blue - retest
Red – test	0.956	0.044	0.000
Green – test	0.142	0.809	0.049
Blue – test	0.000	0.181	0.819

Exact Agreement Rate = 0.924
Kappa = 0.788
N-count = 33,809

Table E–3. Retest Classification Probability – Mathematics Grade 5

	Red - retest	Green - retest	Blue - retest
Red – test	0.953	0.047	0.000
Green – test	0.148	0.810	0.043
Blue – test	0.000	0.198	0.802

Exact Agreement Rate = 0.924
Kappa = 0.775
N-count = 40,610

Table E–4. Retest Classification Probability – Mathematics Grade 6

	Red - retest	Green - retest	Blue - retest
Red – test	0.955	0.045	0.000
Green – test	0.137	0.817	0.045
Blue – test	0.000	0.155	0.845

Exact Agreement Rate = 0.926
Kappa = 0.794
N-count = 47,976

Table E–5. Retest Classification Probability – Mathematics Grade 7

	Red - retest	Green - retest	Blue - retest
Red – test	0.960	0.040	0.000
Green – test	0.150	0.812	0.038
Blue – test	0.000	0.162	0.838

Exact Agreement Rate = 0.934
Kappa = 0.782
N-count = 53,789

Table E–6. Retest Classification Probability – Mathematics Grade 8

	Red - retest	Green - retest	Blue - retest
Red – test	0.962	0.038	0.000
Green – test	0.166	0.798	0.036
Blue – test	0.000	0.155	0.845

Exact Agreement Rate = 0.939
Kappa = 0.764
N-count = 45,784

Table E–7. Retest Classification Probability – Mathematics High School

	Red - retest	Green - retest	Blue - retest
Red – test	0.972	0.028	0.000
Green – test	0.157	0.840	0.003
Blue – test	0.000	0.000	0.000

Exact Agreement Rate = 0.969
Kappa = 0.628
N-count = 642

Table E–8. Retest Classification Probability – Algebra I

	Red - retest	Green - retest	Blue - retest
Red – test	0.956	0.044	0.000
Green – test	0.164	0.803	0.033
Blue – test	0.000	0.170	0.830

Exact Agreement Rate = 0.932
Kappa = 0.759
N-count = 76,958

Table E–9. Retest Classification Probability – Geometry

	Red - retest	Green - retest	Blue - retest
Red – test	0.949	0.051	0.000
Green – test	0.140	0.816	0.044
Blue – test	0.000	0.164	0.836

Exact Agreement Rate = 0.919
Kappa = 0.782
N-count = 8,595

Table E–10. Retest Classification Probability – Algebra II

	Red - retest	Green - retest	Blue - retest
Red – test	0.960	0.040	0.000
Green – test	0.142	0.811	0.047
Blue – test	0.000	0.163	0.837

Exact Agreement Rate = 0.933
Kappa = 0.790
N-count = 8,299

Table E–11. Retest Classification Probability – Reading Grade 3

	Red - retest	Green - retest	Blue - retest
Red – test	0.945	0.055	0.000
Green – test	0.091	0.854	0.055
Blue – test	0.000	0.190	0.810

Exact Agreement Rate = 0.907
Kappa = 0.821
N-count = 29,868

Table E–12. Retest Classification Probability – Reading Grade 4

	Red - retest	Green - retest	Blue - retest
Red – test	0.944	0.056	0.000
Green – test	0.089	0.857	0.055
Blue – test	0.000	0.220	0.780

Exact Agreement Rate = 0.904
Kappa = 0.817
N-count = 32,775

Table E–13. Retest Classification Probability – Reading Grade 5

	Red - retest	Green - retest	Blue - retest
Red – test	0.943	0.057	0.000
Green – test	0.088	0.864	0.048
Blue – test	0.000	0.251	0.749

Exact Agreement Rate = 0.905
Kappa = 0.817
N-count = 37,823

Table E–14. Retest Classification Probability – Reading Grade 6

	Red - retest	Green - retest	Blue - retest
Red – test	0.936	0.064	0.000
Green – test	0.109	0.857	0.033
Blue – test	0.000	0.255	0.745

Exact Agreement Rate = 0.903
Kappa = 0.803
N-count = 40,440

Table E–15. Retest Classification Probability – Reading Grade 7

	Red - retest	Green - retest	Blue - retest
Red – test	0.939	0.061	0.000
Green – test	0.114	0.855	0.031
Blue – test	0.000	0.259	0.741

Exact Agreement Rate = 0.907
Kappa = 0.804
N-count = 41,229

Table E–16. Retest Classification Probability – Reading Grade 8

	Red - retest	Green - retest	Blue - retest
Red – test	0.943	0.057	0.000
Green – test	0.121	0.851	0.028
Blue – test	0.000	0.260	0.740

Exact Agreement Rate = 0.913
Kappa = 0.803
N-count = 40,378

Table E–17. Retest Classification Probability – Literature

	Red - retest	Green - retest	Blue - retest
Red – test	0.936	0.064	0.000
Green – test	0.106	0.857	0.037
Blue – test	0.000	0.269	0.731

Exact Agreement Rate = 0.901
Kappa = 0.803
N-count = 103,750

Table E–18. Retest Classification Probability – Science Grade 3

	Red - retest	Green - retest	Blue - retest
Red – test	0.938	0.062	0.000
Green – test	0.101	0.824	0.075
Blue – test	0.000	0.165	0.835

Exact Agreement Rate = 0.883
Kappa = 0.802
N-count = 3,319

Table E–19. Retest Classification Probability – Science Grade 4

	Red - retest	Green - retest	Blue - retest
Red – test	0.921	0.079	0.000
Green – test	0.100	0.825	0.075
Blue – test	0.000	0.190	0.810

Exact Agreement Rate = 0.867
Kappa = 0.777
N-count = 19,845

Table E–20. Retest Classification Probability – Science Grade 5

	Red - retest	Green - retest	Blue - retest
Red – test	0.929	0.071	0.000
Green – test	0.106	0.825	0.069
Blue – test	0.000	0.203	0.797

Exact Agreement Rate = 0.882
Kappa = 0.784
N-count = 7,859

Table E–21. Retest Classification Probability – Science Grade 6

	Red - retest	Green - retest	Blue - retest
Red – test	0.934	0.066	0.000
Green – test	0.116	0.833	0.051
Blue – test	0.000	0.228	0.772

Exact Agreement Rate = 0.892
Kappa = 0.788
N-count = 18,008

Table E–22. Retest Classification Probability – Science Grade 7

	Red - retest	Green - retest	Blue - retest
Red – test	0.936	0.064	0.000
Green – test	0.126	0.832	0.042
Blue – test	0.000	0.240	0.760

Exact Agreement Rate = 0.898
Kappa = 0.784
N-count = 28,568

Table E–23. Retest Classification Probability – Science Grade 8

	Red - retest	Green - retest	Blue - retest
Red – test	0.936	0.064	0.000
Green – test	0.136	0.828	0.035
Blue – test	0.000	0.235	0.765

Exact Agreement Rate = 0.901
Kappa = 0.778
N-count = 45,976

Table E–24. Retest Classification Probability – Science High School

	Red - retest	Green - retest	Blue - retest
Red – test	0.961	0.039	0.000
Green – test	0.189	0.792	0.019
Blue – test	0.000	0.162	0.838

Exact Agreement Rate = 0.939
Kappa = 0.741
N-count = 2,207

Table E–25. Retest Classification Probability – Biology

	Red - retest	Green - retest	Blue - retest
Red – test	0.934	0.066	0.000
Green – test	0.141	0.816	0.043
Blue – test	0.000	0.171	0.829

Exact Agreement Rate = 0.898
Kappa = 0.774
N-count = 87,485

Table E–26. Retest Classification Probability – Chemistry

	Red - retest	Green - retest	Blue - retest
Red – test	0.931	0.069	0.000
Green – test	0.168	0.809	0.023
Blue – test	0.000	0.217	0.783

Exact Agreement Rate = 0.901
Kappa = 0.737
N-count = 6,302

Table E–27. Retest Classification Probability – Writing Grade 3

	Red - retest	Green - retest	Blue - retest
Red – test	0.950	0.050	0.000
Green – test	0.115	0.834	0.052
Blue – test	0.000	0.201	0.799

Exact Agreement Rate = 0.909
Kappa = 0.809
N-count = 3,669

Table E–28. Retest Classification Probability – Writing Grade 4

	Red - retest	Green - retest	Blue - retest
Red – test	0.946	0.054	0.000
Green – test	0.122	0.837	0.041
Blue – test	0.000	0.266	0.734

Exact Agreement Rate = 0.905
Kappa = 0.799
N-count = 4,424

Table E–29. Retest Classification Probability – Writing Grade 5

	Red - retest	Green - retest	Blue - retest
Red – test	0.937	0.063	0.000
Green – test	0.123	0.831	0.047
Blue – test	0.000	0.253	0.747

Exact Agreement Rate = 0.897
Kappa = 0.784
N-count = 5,602

Table E–30. Retest Classification Probability – Writing Grade 6

	Red - retest	Green - retest	Blue - retest
Red – test	0.933	0.067	0.000
Green – test	0.118	0.834	0.048
Blue – test	0.000	0.195	0.805

Exact Agreement Rate = 0.893
Kappa = 0.791
N-count = 8,801

Table E–31. Retest Classification Probability – Writing Grade 7

	Red - retest	Green - retest	Blue - retest
Red – test	0.936	0.064	0.000
Green – test	0.110	0.841	0.049
Blue – test	0.000	0.206	0.794

Exact Agreement Rate = 0.897
Kappa = 0.797
N-count = 11,917

Table E–32. Retest Classification Probability – Writing Grade 8

	Red - retest	Green - retest	Blue - retest
Red – test	0.942	0.058	0.000
Green – test	0.110	0.845	0.045
Blue – test	0.000	0.194	0.806

Exact Agreement Rate = 0.903
Kappa = 0.807
N-count = 11,553

Table E–33. Retest Classification Probability – English Composition

	Red - retest	Green - retest	Blue - retest
Red – test	0.953	0.047	0.000
Green – test	0.105	0.845	0.050
Blue – test	0.000	0.181	0.819

Exact Agreement Rate = 0.912
Kappa = 0.824
N-count = 6,228

RETEST CLASSIFICATION PERCENT FOR VARIOUS SCALE SCORE RANGES

Tables E–34 through E–66 show the percent chance of scoring in each color range if retested without additional instruction for various scale scores ranges.

Table E–34. Retest Classification Percent for Various Scale Score Ranges – Mathematics Grade 3

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	15	>99.9%	0.0%	0.0%	>99.9%
250 to 299	107	>99.9%	0.0%	0.0%	>99.9%
300 to 349	325	>99.9%	0.0%	0.0%	>99.9%
350 to 399	830	>99.9%	0.0%	0.0%	>99.9%
400 to 449	1,284	>99.9%	0.0%	0.0%	>99.9%
450 to 499	1,690	>99.9%	0.0%	0.0%	>99.9%
500 to 549	2,166	>99.9%	0.0%	0.0%	>99.9%
550 to 599	2,829	>99.9%	0.0%	0.0%	>99.9%
600 to 649	3,196	>99.9%	0.0%	0.0%	>99.9%
650 to 699	3,505	>99.9%	0.0%	0.0%	>99.9%
700 to 749	3,903	99.1%	0.9%	0.0%	99.1%
750 to 799	3,871	87.4%	12.6%	0.0%	87.4%
800 to 849 (Red/Green cut = 822)	3,272	47.9%	52.0%	0.0%	62.2%
850 to 899	2,412	10.3%	89.3%	0.3%	89.3%
900 to 949	1,521	0.7%	92.7%	6.6%	92.7%
950 to 999 (Green/Blue cut = 985)	854	0.0%	62.3%	37.7%	66.2%
1000 to 1049	418	0.0%	19.0%	81.0%	81.0%
1050 to 1099	197	0.0%	1.8%	98.2%	98.2%
1100 to 1149	83	0.0%	0.0%	>99.9%	>99.9%
1150 to 1199	51	0.0%	0.0%	>99.9%	>99.9%
1200 to 1249	13	0.0%	0.0%	>99.9%	>99.9%
1250 to 1299	5	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	5	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	2	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	2	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	32,556				

* Retest assuming no additional instruction

Table E–35. Retest Classification Percent for Various Scale Score Ranges – Mathematics Grade 4

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	3	>99.9%	0.0%	0.0%	>99.9%
300 to 349	28	>99.9%	0.0%	0.0%	>99.9%
350 to 399	146	>99.9%	0.0%	0.0%	>99.9%
400 to 449	502	>99.9%	0.0%	0.0%	>99.9%
450 to 499	908	>99.9%	0.0%	0.0%	>99.9%
500 to 549	1,273	>99.9%	0.0%	0.0%	>99.9%
550 to 599	1,702	>99.9%	0.0%	0.0%	>99.9%
600 to 649	2,186	>99.9%	0.0%	0.0%	>99.9%
650 to 699	2,935	>99.9%	0.0%	0.0%	>99.9%
700 to 749	3,519	>99.9%	0.0%	0.0%	>99.9%
750 to 799	4,278	>99.9%	0.0%	0.0%	>99.9%
800 to 849	4,406	98.0%	2.0%	0.0%	98.0%
850 to 899	3,923	80.4%	19.6%	0.0%	80.4%
900 to 949 (Red/Green cut = 910)	3,095	36.5%	63.5%	0.0%	65.6%
950 to 999	2,165	6.1%	93.1%	0.7%	93.1%
1000 to 1049	1,285	0.3%	88.7%	11.1%	88.7%
1050 to 1099 (Green/Blue cut = 1073)	768	0.0%	50.6%	49.4%	62.2%
1100 to 1149	393	0.0%	12.4%	87.6%	87.6%
1150 to 1199	177	0.0%	0.9%	99.1%	99.1%
1200 to 1249	68	0.0%	0.0%	>99.9%	>99.9%
1250 to 1299	23	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	15	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	10	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	1	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	33,809				

* Retest assuming no additional instruction

Table E–36. Retest Classification Percent for Various Scale Score Ranges – Mathematics Grade 5

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	1	>99.9%	0.0%	0.0%	>99.9%
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	7	>99.9%	0.0%	0.0%	>99.9%
350 to 399	34	>99.9%	0.0%	0.0%	>99.9%
400 to 449	198	>99.9%	0.0%	0.0%	>99.9%
450 to 499	572	>99.9%	0.0%	0.0%	>99.9%
500 to 549	1,095	>99.9%	0.0%	0.0%	>99.9%
550 to 599	1,624	>99.9%	0.0%	0.0%	>99.9%
600 to 649	2,024	>99.9%	0.0%	0.0%	>99.9%
650 to 699	2,659	>99.9%	0.0%	0.0%	>99.9%
700 to 749	3,455	>99.9%	0.0%	0.0%	>99.9%
750 to 799	4,431	>99.9%	0.0%	0.0%	>99.9%
800 to 849	5,215	99.9%	0.1%	0.0%	99.9%
850 to 899	5,357	97.8%	2.2%	0.0%	97.8%
900 to 949	4,959	79.0%	21.0%	0.0%	79.0%
950 to 999 (Red/Green cut = 958)	3,922	34.8%	65.2%	0.0%	66.6%
1000 to 1049	2,542	5.4%	93.7%	0.8%	93.7%
1050 to 1099	1,429	0.2%	88.2%	11.6%	88.2%
1100 to 1149 (Green/Blue cut = 1121)	648	0.0%	50.6%	49.4%	61.9%
1150 to 1199	260	0.0%	11.8%	88.2%	88.2%
1200 to 1249	104	0.0%	0.6%	99.4%	99.4%
1250 to 1299	45	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	17	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	3	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	3	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	2	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	3	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	1	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	40,610				

* Retest assuming no additional instruction

Table E–37. Retest Classification Percent for Various Scale Score Ranges – Mathematics Grade 6

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	2	>99.9%	0.0%	0.0%	>99.9%
400 to 449	9	>99.9%	0.0%	0.0%	>99.9%
450 to 499	89	>99.9%	0.0%	0.0%	>99.9%
500 to 549	359	>99.9%	0.0%	0.0%	>99.9%
550 to 599	1,005	>99.9%	0.0%	0.0%	>99.9%
600 to 649	1,736	>99.9%	0.0%	0.0%	>99.9%
650 to 699	2,227	>99.9%	0.0%	0.0%	>99.9%
700 to 749	2,936	>99.9%	0.0%	0.0%	>99.9%
750 to 799	3,842	>99.9%	0.0%	0.0%	>99.9%
800 to 849	4,790	>99.9%	0.0%	0.0%	>99.9%
850 to 899	5,842	>99.9%	0.0%	0.0%	>99.9%
900 to 949	6,228	99.3%	0.7%	0.0%	99.3%
950 to 999	5,905	88.3%	11.7%	0.0%	88.3%
1000 to 1049 (Red/Green cut = 1023)	4,918	48.6%	51.4%	0.0%	63.0%
1050 to 1099	3,507	10.0%	89.8%	0.2%	89.8%
1100 to 1149	2,099	0.5%	93.9%	5.5%	93.9%
1150 to 1199 (Green/Blue cut = 1186)	1,223	0.0%	64.2%	35.8%	67.1%
1200 to 1249	657	0.0%	17.7%	82.3%	82.3%
1250 to 1299	333	0.0%	1.4%	98.6%	98.6%
1300 to 1349	152	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	61	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	34	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	12	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	4	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	1	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	3	0.0%	0.0%	>99.9%	>99.9%
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	2	0.0%	0.0%	>99.9%	>99.9%
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	47,976				

* Retest assuming no additional instruction

Table E–38. Retest Classification Percent for Various Scale Score Ranges – Mathematics Grade 7

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	5	>99.9%	0.0%	0.0%	>99.9%
450 to 499	41	>99.9%	0.0%	0.0%	>99.9%
500 to 549	181	>99.9%	0.0%	0.0%	>99.9%
550 to 599	661	>99.9%	0.0%	0.0%	>99.9%
600 to 649	1,319	>99.9%	0.0%	0.0%	>99.9%
650 to 699	1,855	>99.9%	0.0%	0.0%	>99.9%
700 to 749	2,494	>99.9%	0.0%	0.0%	>99.9%
750 to 799	3,477	>99.9%	0.0%	0.0%	>99.9%
800 to 849	4,493	>99.9%	0.0%	0.0%	>99.9%
850 to 899	5,581	>99.9%	0.0%	0.0%	>99.9%
900 to 949	6,733	>99.9%	0.0%	0.0%	>99.9%
950 to 999	7,109	99.6%	0.4%	0.0%	99.6%
1000 to 1049	6,757	92.4%	7.6%	0.0%	92.4%
1050 to 1099 (Red/Green cut = 1082)	5,407	57.8%	42.2%	0.0%	64.1%
1100 to 1149	3,636	14.8%	85.1%	0.1%	85.1%
1150 to 1199	2,073	1.0%	95.7%	3.3%	95.7%
1200 to 1249 (Green/Blue cut = 1245)	1,029	0.0%	72.0%	28.0%	72.3%
1250 to 1299	505	0.0%	24.4%	75.6%	75.6%
1300 to 1349	212	0.0%	2.6%	97.4%	97.4%
1350 to 1399	133	0.0%	0.1%	99.9%	99.9%
1400 to 1449	54	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	17	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	6	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	10	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	1	0.0%	0.0%	>99.9%	>99.9%
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	53,789				

* Retest assuming no additional instruction

Table E–39. Retest Classification Percent for Various Scale Score Ranges – Mathematics Grade 8

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	3	>99.9%	0.0%	0.0%	>99.9%
450 to 499	32	>99.9%	0.0%	0.0%	>99.9%
500 to 549	95	>99.9%	0.0%	0.0%	>99.9%
550 to 599	448	>99.9%	0.0%	0.0%	>99.9%
600 to 649	995	>99.9%	0.0%	0.0%	>99.9%
650 to 699	1,471	>99.9%	0.0%	0.0%	>99.9%
700 to 749	2,104	>99.9%	0.0%	0.0%	>99.9%
750 to 799	2,634	>99.9%	0.0%	0.0%	>99.9%
800 to 849	3,176	>99.9%	0.0%	0.0%	>99.9%
850 to 899	4,172	>99.9%	0.0%	0.0%	>99.9%
900 to 949	4,777	>99.9%	0.0%	0.0%	>99.9%
950 to 999	5,561	>99.9%	0.0%	0.0%	>99.9%
1000 to 1049	6,115	99.2%	0.8%	0.0%	99.2%
1050 to 1099	5,634	87.9%	12.1%	0.0%	87.9%
1100 to 1149 (Red/Green cut = 1121)	4,141	47.6%	52.4%	0.0%	62.8%
1150 to 1199	2,122	9.4%	90.4%	0.2%	90.4%
1200 to 1249	1,103	0.5%	93.8%	5.7%	93.8%
1250 to 1299 (Green/Blue cut = 1284)	599	0.0%	61.4%	38.6%	66.0%
1300 to 1349	303	0.0%	17.0%	83.0%	83.0%
1350 to 1399	172	0.0%	1.2%	98.8%	98.8%
1400 to 1449	77	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	32	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	13	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	3	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	2	0.0%	0.0%	>99.9%	>99.9%
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	45,784				

* Retest assuming no additional instruction

Table E–40. Retest Classification Percent for Various Scale Score Ranges – Mathematics High School

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 400	0	N/A	N/A	N/A	N/A
400 to 449	1	>99.9%	0.0%	0.0%	>99.9%
450 to 499	0	N/A	N/A	N/A	N/A
500 to 549	2	>99.9%	0.0%	0.0%	>99.9%
3550 to 3599	12	>99.9%	0.0%	0.0%	>99.9%
600 to 649	17	>99.9%	0.0%	0.0%	>99.9%
650 to 699	29	>99.9%	0.0%	0.0%	>99.9%
700 to 749	48	>99.9%	0.0%	0.0%	>99.9%
750 to 799	52	>99.9%	0.0%	0.0%	>99.9%
800 to 849	67	>99.9%	0.0%	0.0%	>99.9%
850 to 899	68	>99.9%	0.0%	0.0%	>99.9%
900 to 949	75	>99.9%	0.0%	0.0%	>99.9%
950 to 999	87	>99.9%	0.0%	0.0%	>99.9%
1000 to 1049	85	99.2%	0.8%	0.0%	99.2%
1050 to 1099	53	88.7%	11.3%	0.0%	88.7%
1100 to 1149 (Red/Green cut = 1134)	32	51.0%	49.0%	0.0%	62.2%
1150 to 1199	12	9.8%	90.0%	0.2%	90.0%
1200 to 1249	2	1.0%	97.4%	1.6%	97.4%
1250 to 1299 (Green/Blue cut = 1297)	0	N/A	N/A	N/A	N/A
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	642				

* Retest assuming no additional instruction

Table E–41. Retest Classification Percent for Various Scale Score Ranges – Algebra I

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 400	0	N/A	N/A	N/A	N/A
400 to 449	0	N/A	N/A	N/A	N/A
450 to 499	3	>99.9%	0.0%	0.0%	>99.9%
500 to 549	47	>99.9%	0.0%	0.0%	>99.9%
550 to 599	332	>99.9%	0.0%	0.0%	>99.9%
600 to 649	1,117	>99.9%	0.0%	0.0%	>99.9%
650 to 699	2,199	>99.9%	0.0%	0.0%	>99.9%
700 to 749	2,998	>99.9%	0.0%	0.0%	>99.9%
750 to 799	3,857	>99.9%	0.0%	0.0%	>99.9%
800 to 849	4,764	>99.9%	0.0%	0.0%	>99.9%
850 to 899	5,901	>99.9%	0.0%	0.0%	>99.9%
900 to 949	7,227	>99.9%	0.0%	0.0%	>99.9%
950 to 999	8,822	>99.9%	0.0%	0.0%	>99.9%
1000 to 1049	10,504	99.7%	0.3%	0.0%	99.7%
1050 to 1099	10,726	93.1%	6.9%	0.0%	93.1%
1100 to 1149 (Red/Green cut = 1134)	8,592	60.4%	39.6%	0.0%	65.0%
1150 to 1199	5,065	16.4%	83.5%	0.1%	83.5%
1200 to 1249	2,516	1.2%	96.1%	2.7%	96.1%
1250 to 1299 (Green/Blue cut = 1297)	1,248	0.0%	74.4%	25.5%	74.5%
1300 to 1349	593	0.0%	25.9%	74.1%	74.1%
1350 to 1399	247	0.0%	2.8%	97.2%	97.2%
1400 to 1449	120	0.0%	0.1%	99.9%	99.9%
1450 to 1499	41	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	19	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	10	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	3	0.0%	0.0%	>99.9%	>99.9%
1650 to 1699	3	0.0%	0.0%	>99.9%	>99.9%
1700 to 1749	2	0.0%	0.0%	>99.9%	>99.9%
1750 to 1799	1	0.0%	0.0%	>99.9%	>99.9%
1800 to 1849	1	0.0%	0.0%	>99.9%	>99.9%
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	76,958				

* Retest assuming no additional instruction

Table E–42. Retest Classification Percent for Various Scale Score Ranges – Geometry

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 400	0	N/A	N/A	N/A	N/A
400 to 449	1	>99.9%	0.0%	0.0%	>99.9%
450 to 499	4	>99.9%	0.0%	0.0%	>99.9%
500 to 549	14	>99.9%	0.0%	0.0%	>99.9%
550 to 599	35	>99.9%	0.0%	0.0%	>99.9%
600 to 649	68	>99.9%	0.0%	0.0%	>99.9%
650 to 699	120	>99.9%	0.0%	0.0%	>99.9%
700 to 749	156	>99.9%	0.0%	0.0%	>99.9%
750 to 799	226	>99.9%	0.0%	0.0%	>99.9%
800 to 849	291	>99.9%	0.0%	0.0%	>99.9%
850 to 899	417	>99.9%	0.0%	0.0%	>99.9%
900 to 949	572	>99.9%	0.0%	0.0%	>99.9%
950 to 999	798	>99.9%	0.0%	0.0%	>99.9%
1000 to 1049	1,093	>99.9%	0.0%	0.0%	>99.9%
1050 to 1099	1,290	98.8%	1.2%	0.0%	98.8%
1100 to 1149	1,261	84.6%	15.4%	0.0%	84.6%
1150 to 1199 (Red/Green cut = 1165)	899	41.1%	58.9%	0.0%	63.8%
1200 to 1249	587	6.7%	92.9%	0.4%	92.9%
1250 to 1299	376	0.3%	92.0%	7.7%	92.0%
1300 to 1349 (Green/Blue cut = 1328)	205	0.0%	56.0%	44.0%	64.3%
1350 to 1399	84	0.0%	13.5%	86.5%	86.5%
1400 to 1449	52	0.0%	1.1%	98.9%	98.9%
1450 to 1499	22	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	15	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	2	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	5	0.0%	0.0%	>99.9%	>99.9%
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	2	0.0%	0.0%	>99.9%	>99.9%
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	8,595				

* Retest assuming no additional instruction

Table E–43. Retest Classification Percent for Various Scale Score Ranges – Algebra II

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 400	0	N/A	N/A	N/A	N/A
400 to 449	0	N/A	N/A	N/A	N/A
450 to 499	0	N/A	N/A	N/A	N/A
500 to 549	1	>99.9%	0.0%	0.0%	>99.9%
550 to 599	3	>99.9%	0.0%	0.0%	>99.9%
600 to 649	20	>99.9%	0.0%	0.0%	>99.9%
650 to 699	81	>99.9%	0.0%	0.0%	>99.9%
700 to 749	144	>99.9%	0.0%	0.0%	>99.9%
750 to 799	224	>99.9%	0.0%	0.0%	>99.9%
800 to 849	250	>99.9%	0.0%	0.0%	>99.9%
850 to 899	337	>99.9%	0.0%	0.0%	>99.9%
900 to 949	409	>99.9%	0.0%	0.0%	>99.9%
950 to 999	572	>99.9%	0.0%	0.0%	>99.9%
1000 to 1049	851	>99.9%	0.0%	0.0%	>99.9%
1050 to 1099	1,106	>99.9%	0.0%	0.0%	>99.9%
1100 to 1149	1,205	99.5%	0.5%	0.0%	99.5%
1150 to 1199	1,075	91.4%	8.6%	0.0%	91.4%
1200 to 1249 (Red/Green cut = 1228)	786	53.1%	46.9%	0.0%	62.7%
1250 to 1299	510	12.5%	87.4%	0.1%	87.4%
1300 to 1349	346	0.7%	95.2%	4.1%	95.2%
1350 to 1399 (Green/Blue cut = 1391)	193	0.0%	68.6%	31.4%	69.7%
1400 to 1449	102	0.0%	22.4%	77.6%	77.6%
1450 to 1499	52	0.0%	2.4%	97.6%	97.6%
1500 to 1549	19	0.0%	0.1%	99.9%	99.9%
1550 to 1599	7	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	2	0.0%	0.0%	>99.9%	>99.9%
1650 to 1699	3	0.0%	0.0%	>99.9%	>99.9%
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	1	0.0%	0.0%	>99.9%	>99.9%
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	8,299				

* Retest assuming no additional instruction

Table E–44. Retest Classification Percent for Various Scale Score Ranges – Reading Grade 3

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	1	>99.9%	0.0%	0.0%	>99.9%
300 to 349	1	>99.9%	0.0%	0.0%	>99.9%
350 to 399	43	>99.9%	0.0%	0.0%	>99.9%
400 to 449	291	>99.9%	0.0%	0.0%	>99.9%
450 to 499	1,161	>99.9%	0.0%	0.0%	>99.9%
500 to 549	2,918	>99.9%	0.0%	0.0%	>99.9%
550 to 599	4,226	>99.9%	0.0%	0.0%	>99.9%
600 to 649	3,981	99.5%	0.5%	0.0%	99.5%
650 to 699	3,203	93.5%	6.5%	0.0%	93.5%
700 to 749 (Red/Green cut = 741)	2,944	63.8%	36.2%	0.0%	65.6%
750 to 799	2,683	21.6%	78.4%	0.0%	78.4%
800 to 849	2,603	2.7%	97.2%	0.1%	97.2%
850 to 899	2,095	0.1%	96.7%	3.2%	96.7%
900 to 949	1,621	0.0%	76.9%	23.1%	76.9%
950 to 999 (Green/Blue cut = 956)	1,127	0.0%	36.6%	63.4%	64.5%
1000 to 1049	603	0.0%	7.9%	92.1%	92.1%
1050 to 1099	241	0.0%	0.9%	99.1%	99.1%
1100 to 1149	92	0.0%	0.1%	99.9%	99.9%
1150 to 1199	27	0.0%	0.0%	>99.9%	>99.9%
1200 to 1249	5	0.0%	0.0%	>99.9%	>99.9%
1250 to 1299	1	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	1	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	29,868				

* Retest assuming no additional instruction

Table E–45. Retest Classification Percent for Various Scale Score Ranges – Reading Grade 4

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	7	>99.9%	0.0%	0.0%	>99.9%
400 to 449	50	>99.9%	0.0%	0.0%	>99.9%
450 to 499	405	>99.9%	0.0%	0.0%	>99.9%
500 to 549	1,387	>99.9%	0.0%	0.0%	>99.9%
550 to 599	2,844	>99.9%	0.0%	0.0%	>99.9%
600 to 649	3,209	>99.9%	0.0%	0.0%	>99.9%
650 to 699	3,213	>99.9%	0.0%	0.0%	>99.9%
700 to 749	3,056	99.0%	1.0%	0.0%	99.0%
750 to 799	3,266	88.0%	12.0%	0.0%	88.0%
800 to 849 (Red/Green cut = 826)	3,274	50.5%	49.5%	0.0%	61.8%
850 to 899	3,242	12.8%	87.2%	0.0%	87.2%
900 to 949	3,058	1.2%	98.4%	0.4%	98.4%
950 to 999	2,567	0.0%	93.2%	6.7%	93.2%
1000 to 1049 (Green/Blue cut = 1041)	1,728	0.0%	65.6%	34.4%	66.6%
1050 to 1099	922	0.0%	26.2%	73.8%	73.8%
1100 to 1149	376	0.0%	5.5%	94.5%	94.5%
1150 to 1199	126	0.0%	0.7%	99.3%	99.3%
1200 to 1249	33	0.0%	0.1%	99.9%	99.9%
1250 to 1299	10	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	2	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	32,775				

* Retest assuming no additional instruction

Table E–46. Retest Classification Percent for Various Scale Score Ranges – Reading Grade 5

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	1	>99.9%	0.0%	0.0%	>99.9%
350 to 399	1	>99.9%	0.0%	0.0%	>99.9%
400 to 449	16	>99.9%	0.0%	0.0%	>99.9%
450 to 499	103	>99.9%	0.0%	0.0%	>99.9%
500 to 549	531	>99.9%	0.0%	0.0%	>99.9%
550 to 599	1,526	>99.9%	0.0%	0.0%	>99.9%
600 to 649	2,911	>99.9%	0.0%	0.0%	>99.9%
650 to 699	3,391	>99.9%	0.0%	0.0%	>99.9%
700 to 749	3,317	>99.9%	0.0%	0.0%	>99.9%
750 to 799	3,304	99.6%	0.4%	0.0%	99.6%
800 to 849	3,616	93.2%	6.8%	0.0%	93.2%
850 to 899 (Red/Green cut = 890)	3,851	62.9%	37.1%	0.0%	65.1%
900 to 949	4,040	20.5%	79.5%	0.0%	79.5%
950 to 999	4,116	2.6%	97.2%	0.1%	97.2%
1000 to 1049	3,361	0.1%	96.5%	3.4%	96.5%
1050 to 1099	2,205	0.0%	76.9%	23.1%	76.9%
1100 to 1149 (Green/Blue cut = 1105)	1,061	0.0%	37.4%	62.6%	63.5%
1150 to 1199	354	0.0%	9.4%	90.6%	90.6%
1200 to 1249	94	0.0%	1.4%	98.6%	98.6%
1250 to 1299	19	0.0%	0.2%	99.8%	99.8%
1300 to 1349	5	0.0%	0.1%	99.9%	99.9%
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	37,823				

* Retest assuming no additional instruction

Table E–47. Retest Classification Percent for Various Scale Score Ranges – Reading Grade 6

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	1	>99.9%	0.0%	0.0%	>99.9%
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	2	>99.9%	0.0%	0.0%	>99.9%
450 to 499	15	>99.9%	0.0%	0.0%	>99.9%
500 to 549	94	>99.9%	0.0%	0.0%	>99.9%
550 to 599	483	>99.9%	0.0%	0.0%	>99.9%
600 to 649	1,567	>99.9%	0.0%	0.0%	>99.9%
650 to 699	2,841	>99.9%	0.0%	0.0%	>99.9%
700 to 749	3,578	>99.9%	0.0%	0.0%	>99.9%
750 to 799	3,594	>99.9%	0.0%	0.0%	>99.9%
800 to 849	3,837	99.7%	0.3%	0.0%	99.7%
850 to 899	4,352	94.7%	5.3%	0.0%	94.7%
900 to 949 (Red/Green cut = 945)	4,960	67.1%	32.9%	0.0%	67.7%
950 to 999	5,122	23.9%	76.1%	0.0%	76.1%
1000 to 1049	4,248	3.2%	96.7%	0.1%	96.7%
1050 to 1099	2,984	0.2%	97.5%	2.4%	97.5%
1100 to 1149	1,660	0.0%	80.3%	19.7%	80.3%
1150 to 1199 (Green/Blue cut = 1160)	747	0.0%	41.0%	59.0%	61.7%
1200 to 1249	264	0.0%	11.6%	88.4%	88.4%
1250 to 1299	78	0.0%	2.5%	97.5%	97.5%
1300 to 1349	12	0.0%	0.5%	99.5%	99.5%
1350 to 1399	1	0.0%	0.1%	99.9%	99.9%
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	40,440				

* Retest assuming no additional instruction

Table E–48. Retest Classification Percent for Various Scale Score Ranges – Reading Grade 7

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	1	>99.9%	0.0%	0.0%	>99.9%
450 to 499	18	>99.9%	0.0%	0.0%	>99.9%
500 to 549	86	>99.9%	0.0%	0.0%	>99.9%
550 to 599	508	>99.9%	0.0%	0.0%	>99.9%
600 to 649	1,447	>99.9%	0.0%	0.0%	>99.9%
650 to 699	2,783	>99.9%	0.0%	0.0%	>99.9%
700 to 749	3,234	>99.9%	0.0%	0.0%	>99.9%
750 to 799	3,391	>99.9%	0.0%	0.0%	>99.9%
800 to 849	3,477	>99.9%	0.0%	0.0%	>99.9%
850 to 899	3,930	99.2%	0.8%	0.0%	99.2%
900 to 949	4,639	89.2%	10.8%	0.0%	89.2%
950 to 999 (Red/Green cut = 979)	5,095	53.2%	46.8%	0.0%	62.2%
1000 to 1049	4,826	14.4%	85.6%	0.0%	85.6%
1050 to 1099	3,718	1.3%	98.4%	0.3%	98.4%
1100 to 1149	2,284	0.1%	94.6%	5.3%	94.6%
1150 to 1199 (Green/Blue cut = 1194)	1,111	0.0%	68.6%	31.4%	69.0%
1200 to 1249	483	0.0%	29.7%	70.3%	70.3%
1250 to 1299	150	0.0%	7.8%	92.2%	92.2%
1300 to 1349	41	0.0%	1.4%	98.6%	98.6%
1350 to 1399	6	0.0%	0.3%	99.7%	99.7%
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	1	0.0%	0.1%	99.9%	99.9%
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	41,229				

* Retest assuming no additional instruction

Table E–49. Retest Classification Percent for Various Scale Score Ranges – Reading Grade 8

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	0	N/A	N/A	N/A	N/A
450 to 499	7	>99.9%	0.0%	0.0%	>99.9%
500 to 549	43	>99.9%	0.0%	0.0%	>99.9%
550 to 599	230	>99.9%	0.0%	0.0%	>99.9%
600 to 649	963	>99.9%	0.0%	0.0%	>99.9%
650 to 699	2,266	>99.9%	0.0%	0.0%	>99.9%
700 to 749	3,286	>99.9%	0.0%	0.0%	>99.9%
750 to 799	3,525	>99.9%	0.0%	0.0%	>99.9%
800 to 849	3,502	>99.9%	0.0%	0.0%	>99.9%
850 to 899	3,723	99.9%	0.1%	0.0%	99.9%
900 to 949	4,196	97.6%	2.4%	0.0%	97.6%
950 to 999	4,646	79.3%	20.7%	0.0%	79.3%
1000 to 1049 (Red/Green cut = 1011)	4,795	37.1%	62.9%	0.0%	65.1%
1050 to 1099	4,063	7.3%	92.7%	0.0%	92.7%
1100 to 1149	2,750	0.5%	98.5%	1.0%	98.5%
1150 to 1199	1,494	0.0%	88.3%	11.6%	88.3%
1200 to 1249 (Green/Blue cut = 1226)	595	0.0%	56.1%	43.9%	61.0%
1250 to 1299	217	0.0%	19.0%	81.0%	81.0%
1300 to 1349	62	0.0%	5.0%	95.0%	95.0%
1350 to 1399	11	0.0%	0.9%	99.1%	99.1%
1400 to 1449	3	0.0%	0.2%	99.8%	99.8%
1450 to 1499	1	0.0%	0.1%	99.9%	99.9%
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	40,378				

* Retest assuming no additional instruction

Table E–50. Retest Classification Percent for Various Scale Score Ranges – Literature

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	0	N/A	N/A	N/A	N/A
450 to 499	6	>99.9%	0.0%	0.0%	>99.9%
500 to 549	60	>99.9%	0.0%	0.0%	>99.9%
550 to 599	338	>99.9%	0.0%	0.0%	>99.9%
600 to 649	1,434	>99.9%	0.0%	0.0%	>99.9%
650 to 699	4,023	>99.9%	0.0%	0.0%	>99.9%
700 to 749	6,412	>99.9%	0.0%	0.0%	>99.9%
750 to 799	7,261	>99.9%	0.0%	0.0%	>99.9%
800 to 849	7,073	>99.9%	0.0%	0.0%	>99.9%
850 to 899	7,520	>99.9%	0.0%	0.0%	>99.9%
900 to 949	8,784	99.3%	0.7%	0.0%	99.3%
950 to 999	10,801	90.5%	9.5%	0.0%	90.5%
1000 to 1049 (Red/Green cut = 1033)	12,543	56.6%	43.4%	0.0%	62.6%
1050 to 1099	12,891	16.6%	83.4%	0.0%	83.4%
1100 to 1149	10,966	2.0%	97.8%	0.3%	97.8%
1150 to 1199	7,427	0.1%	94.8%	5.1%	94.8%
1200 to 1249 (Green/Blue cut = 1248)	3,917	0.0%	71.3%	28.7%	71.3%
1250 to 1299	1,595	0.0%	33.4%	66.6%	66.6%
1300 to 1349	521	0.0%	10.5%	89.5%	89.5%
1350 to 1399	142	0.0%	2.6%	97.4%	97.4%
1400 to 1449	26	0.0%	0.8%	99.2%	99.2%
1450 to 1499	9	0.0%	0.2%	99.8%	99.8%
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	1	0.0%	0.1%	99.9%	99.9%
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	103,750				

* Retest assuming no additional instruction

Table E–51. Retest Classification Percent for Various Scale Score Ranges – Science Grade 3

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	25	>99.9%	0.0%	0.0%	>99.9%
250 to 299	71	>99.9%	0.0%	0.0%	>99.9%
300 to 349	139	>99.9%	0.0%	0.0%	>99.9%
350 to 399	156	>99.9%	0.0%	0.0%	>99.9%
400 to 449	152	>99.9%	0.0%	0.0%	>99.9%
450 to 499	171	>99.9%	0.0%	0.0%	>99.9%
500 to 549	191	>99.9%	0.0%	0.0%	>99.9%
550 to 599	207	99.7%	0.3%	0.0%	99.7%
600 to 649	294	94.2%	5.8%	0.0%	94.2%
650 to 699 (Red/Green cut = 694)	321	65.0%	35.0%	0.0%	66.2%
700 to 749	373	24.5%	75.5%	0.0%	75.5%
750 to 799	403	3.0%	95.4%	1.6%	95.4%
800 to 849	342	0.1%	83.8%	16.1%	83.8%
850 to 899 (Green/Blue cut = 867)	216	0.0%	45.1%	54.9%	61.7%
900 to 949	144	0.0%	9.9%	90.1%	90.1%
950 to 999	67	0.0%	0.8%	99.2%	99.2%
1000 to 1049	26	0.0%	0.0%	>99.9%	>99.9%
1050 to 1099	13	0.0%	0.0%	>99.9%	>99.9%
1100 to 1149	8	0.0%	0.0%	>99.9%	>99.9%
1150 to 1199	0	N/A	N/A	N/A	N/A
1200 to 1249	0	N/A	N/A	N/A	N/A
1250 to 1299	0	N/A	N/A	N/A	N/A
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	3,319				

* Retest assuming no additional instruction

Table E–52. Retest Classification Percent for Various Scale Score Ranges – Science Grade 4

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	5	>99.9%	0.0%	0.0%	>99.9%
250 to 299	41	>99.9%	0.0%	0.0%	>99.9%
300 to 349	154	>99.9%	0.0%	0.0%	>99.9%
350 to 399	412	>99.9%	0.0%	0.0%	>99.9%
400 to 449	667	>99.9%	0.0%	0.0%	>99.9%
450 to 499	767	>99.9%	0.0%	0.0%	>99.9%
500 to 549	849	>99.9%	0.0%	0.0%	>99.9%
550 to 599	1,040	>99.9%	0.0%	0.0%	>99.9%
600 to 649	1,305	99.8%	0.2%	0.0%	99.8%
650 to 699	1,655	95.9%	4.1%	0.0%	95.9%
700 to 749	2,198	71.5%	28.5%	0.0%	71.5%
750 to 799 (Red/Green cut = 751)	2,693	28.3%	71.7%	0.0%	71.7%
800 to 849	2,726	4.2%	94.8%	1.0%	94.8%
850 to 899	2,235	0.2%	87.7%	12.1%	87.7%
900 to 949 (Green/Blue cut = 924)	1,640	0.0%	51.8%	48.2%	61.9%
950 to 999	915	0.0%	13.6%	86.4%	86.4%
1000 to 1049	369	0.0%	1.2%	98.8%	98.8%
1050 to 1099	126	0.0%	0.0%	>99.9%	>99.9%
1100 to 1149	34	0.0%	0.0%	>99.9%	>99.9%
1150 to 1199	12	0.0%	0.0%	>99.9%	>99.9%
1200 to 1249	1	0.0%	0.0%	>99.9%	>99.9%
1250 to 1299	0	N/A	N/A	N/A	N/A
1300 to 1349	1	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	19,845				

* Retest assuming no additional instruction

Table E–53. Retest Classification Percent for Various Scale Score Ranges – Science Grade 5

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	4	>99.9%	0.0%	0.0%	>99.9%
300 to 349	13	>99.9%	0.0%	0.0%	>99.9%
350 to 399	67	>99.9%	0.0%	0.0%	>99.9%
400 to 449	176	>99.9%	0.0%	0.0%	>99.9%
450 to 499	301	>99.9%	0.0%	0.0%	>99.9%
500 to 549	384	>99.9%	0.0%	0.0%	>99.9%
550 to 599	412	>99.9%	0.0%	0.0%	>99.9%
600 to 649	523	>99.9%	0.0%	0.0%	>99.9%
650 to 699	672	99.9%	0.1%	0.0%	99.9%
700 to 749	839	96.6%	3.4%	0.0%	96.6%
750 to 799	968	74.3%	25.7%	0.0%	74.3%
800 to 849 (Red/Green cut = 804)	938	31.3%	68.7%	0.0%	68.9%
850 to 899	931	4.9%	94.3%	0.8%	94.3%
900 to 949	766	0.3%	89.1%	10.6%	89.1%
950 to 999 (Green/Blue cut = 977)	490	0.0%	55.0%	45.0%	61.8%
1000 to 1049	245	0.0%	14.4%	85.6%	85.6%
1050 to 1099	86	0.0%	1.3%	98.7%	98.7%
1100 to 1149	32	0.0%	0.0%	>99.9%	>99.9%
1150 to 1199	10	0.0%	0.0%	>99.9%	>99.9%
1200 to 1249	1	0.0%	0.0%	>99.9%	>99.9%
1250 to 1299	0	N/A	N/A	N/A	N/A
1300 to 1349	1	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	7,859				

* Retest assuming no additional instruction

Table E–54. Retest Classification Percent for Various Scale Score Ranges – Science Grade 6

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	1	>99.9%	0.0%	0.0%	>99.9%
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	15	>99.9%	0.0%	0.0%	>99.9%
450 to 499	127	>99.9%	0.0%	0.0%	>99.9%
500 to 549	503	>99.9%	0.0%	0.0%	>99.9%
550 to 599	1,103	>99.9%	0.0%	0.0%	>99.9%
600 to 649	1,421	>99.9%	0.0%	0.0%	>99.9%
650 to 699	1,526	>99.9%	0.0%	0.0%	>99.9%
700 to 749	1,689	99.9%	0.1%	0.0%	99.9%
750 to 799	1,862	97.9%	2.1%	0.0%	97.9%
800 to 849	2,142	79.4%	20.6%	0.0%	79.4%
850 to 899 (Red/Green cut = 861)	2,442	36.1%	63.9%	0.0%	65.9%
900 to 949	2,211	6.4%	93.2%	0.4%	93.2%
950 to 999	1,632	0.3%	92.6%	7.0%	92.6%
1000 to 1049 (Green/Blue cut = 1034)	842	0.0%	61.9%	38.1%	65.5%
1050 to 1099	368	0.0%	18.7%	81.3%	81.3%
1100 to 1149	91	0.0%	2.0%	98.0%	98.0%
1150 to 1199	24	0.0%	0.0%	>99.9%	>99.9%
1200 to 1249	2	0.0%	0.0%	>99.9%	>99.9%
1250 to 1299	4	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	2	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	1	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	18,008				

* Retest assuming no additional instruction

Table E–55. Retest Classification Percent for Various Scale Score Ranges – Science Grade 7

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	1	>99.9%	0.0%	0.0%	>99.9%
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	1	>99.9%	0.0%	0.0%	>99.9%
400 to 449	8	>99.9%	0.0%	0.0%	>99.9%
450 to 499	104	>99.9%	0.0%	0.0%	>99.9%
500 to 549	523	>99.9%	0.0%	0.0%	>99.9%
550 to 599	1,409	>99.9%	0.0%	0.0%	>99.9%
600 to 649	2,021	>99.9%	0.0%	0.0%	>99.9%
650 to 699	2,267	>99.9%	0.0%	0.0%	>99.9%
700 to 749	2,268	>99.9%	0.0%	0.0%	>99.9%
750 to 799	2,699	99.9%	0.1%	0.0%	99.9%
800 to 849	3,117	97.5%	2.5%	0.0%	97.5%
850 to 899	3,573	77.3%	22.7%	0.0%	77.3%
900 to 949 (Red/Green cut = 908)	3,866	33.9%	66.1%	0.0%	67.3%
950 to 999	3,356	5.8%	93.7%	0.5%	93.7%
1000 to 1049	2,066	0.3%	91.9%	7.8%	91.9%
1050 to 1099 (Green/Blue cut = 1081)	895	0.0%	60.1%	39.9%	64.8%
1100 to 1149	293	0.0%	17.8%	82.2%	82.2%
1150 to 1199	73	0.0%	1.6%	98.4%	98.4%
1200 to 1249	22	0.0%	0.0%	>99.9%	>99.9%
1250 to 1299	4	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	2	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	28,568				

* Retest assuming no additional instruction

Table E–56. Retest Classification Percent for Various Scale Score Ranges – Science Grade 8

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	6	>99.9%	0.0%	0.0%	>99.9%
450 to 499	80	>99.9%	0.0%	0.0%	>99.9%
500 to 549	484	>99.9%	0.0%	0.0%	>99.9%
550 to 599	1,845	>99.9%	0.0%	0.0%	>99.9%
600 to 649	2,989	>99.9%	0.0%	0.0%	>99.9%
650 to 699	3,102	>99.9%	0.0%	0.0%	>99.9%
700 to 749	3,297	>99.9%	0.0%	0.0%	>99.9%
750 to 799	3,566	>99.9%	0.0%	0.0%	>99.9%
800 to 849	4,369	99.8%	0.2%	0.0%	99.8%
850 to 899	5,352	95.8%	4.2%	0.0%	95.8%
900 to 949 (Red/Green cut = 949)	6,210	70.8%	29.2%	0.0%	70.9%
950 to 999	6,279	26.7%	73.3%	0.0%	73.3%
1000 to 1049	4,779	3.7%	95.4%	0.9%	95.4%
1050 to 1099	2,360	0.1%	88.7%	11.1%	88.7%
1100 to 1149 (Green/Blue cut = 1122)	869	0.0%	52.3%	47.7%	61.7%
1150 to 1199	279	0.0%	12.5%	87.5%	87.5%
1200 to 1249	84	0.0%	0.9%	99.1%	99.1%
1250 to 1299	19	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	2	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	5	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	45,976				

* Retest assuming no additional instruction

Table E–57. Retest Classification Percent for Various Scale Score Ranges – Science High School

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 400	0	N/A	N/A	N/A	N/A
400 to 449	0	N/A	N/A	N/A	N/A
450 to 499	4	>99.9%	0.0%	0.0%	>99.9%
500 to 549	39	>99.9%	0.0%	0.0%	>99.9%
550 to 599	150	>99.9%	0.0%	0.0%	>99.9%
600 to 649	167	>99.9%	0.0%	0.0%	>99.9%
650 to 699	165	>99.9%	0.0%	0.0%	>99.9%
700 to 749	202	>99.9%	0.0%	0.0%	>99.9%
750 to 799	208	>99.9%	0.0%	0.0%	>99.9%
800 to 849	209	>99.9%	0.0%	0.0%	>99.9%
850 to 899	233	99.9%	0.1%	0.0%	99.9%
900 to 949	253	98.1%	1.9%	0.0%	98.1%
950 to 999	234	81.1%	18.9%	0.0%	81.1%
1000 to 1049 (Red/Green cut = 1012)	192	40.0%	60.0%	0.0%	63.4%
1050 to 1099	93	7.6%	92.0%	0.3%	92.0%
1100 to 1149	40	0.4%	94.0%	5.6%	94.0%
1150 to 1199 (Green/Blue cut = 1185)	10	0.0%	65.4%	34.6%	67.6%
1200 to 1249	6	0.0%	17.7%	82.3%	82.3%
1250 to 1299	1	0.0%	0.4%	99.6%	99.6%
1300 to 1349	1	0.0%	0.1%	99.9%	99.9%
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	2,207				

* Retest assuming no additional instruction

Table E–58. Retest Classification Percent for Various Scale Score Ranges – Biology

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 400	0	N/A	N/A	N/A	N/A
400 to 449	1	>99.9%	0.0%	0.0%	>99.9%
450 to 499	16	>99.9%	0.0%	0.0%	>99.9%
500 to 549	111	>99.9%	0.0%	0.0%	>99.9%
550 to 599	597	>99.9%	0.0%	0.0%	>99.9%
600 to 649	1,863	>99.9%	0.0%	0.0%	>99.9%
650 to 699	4,182	>99.9%	0.0%	0.0%	>99.9%
700 to 749	5,468	>99.9%	0.0%	0.0%	>99.9%
750 to 799	6,108	>99.9%	0.0%	0.0%	>99.9%
800 to 849	7,153	>99.9%	0.0%	0.0%	>99.9%
850 to 899	8,647	99.9%	0.1%	0.0%	99.9%
900 to 949	10,952	98.0%	2.0%	0.0%	98.0%
950 to 999	12,502	80.6%	19.4%	0.0%	80.6%
1000 to 1049 (Red/Green cut = 1012)	11,522	38.3%	61.7%	0.0%	64.6%
1050 to 1099	8,086	7.0%	92.6%	0.4%	92.6%
1100 to 1149	4,872	0.4%	93.0%	6.6%	93.0%
1150 to 1199 (Green/Blue cut = 1185)	2,747	0.0%	62.4%	37.6%	65.6%
1200 to 1249	1,436	0.0%	18.6%	81.4%	81.4%
1250 to 1299	696	0.0%	1.9%	98.1%	98.1%
1300 to 1349	336	0.0%	0.1%	99.9%	99.9%
1350 to 1399	134	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	42	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	11	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	2	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	1	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	87,485				

* Retest assuming no additional instruction

Table E–59. Retest Classification Percent for Various Scale Score Ranges – Chemistry

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 400	0	N/A	N/A	N/A	N/A
400 to 449	0	N/A	N/A	N/A	N/A
450 to 499	1	>99.9%	0.0%	0.0%	>99.9%
500 to 549	0	N/A	N/A	N/A	N/A
550 to 599	6	>99.9%	0.0%	0.0%	>99.9%
600 to 649	25	>99.9%	0.0%	0.0%	>99.9%
650 to 699	90	>99.9%	0.0%	0.0%	>99.9%
700 to 749	177	>99.9%	0.0%	0.0%	>99.9%
750 to 799	326	>99.9%	0.0%	0.0%	>99.9%
800 to 849	508	>99.9%	0.0%	0.0%	>99.9%
850 to 899	719	>99.9%	0.0%	0.0%	>99.9%
900 to 949	908	99.8%	0.2%	0.0%	99.8%
950 to 999	1,063	95.1%	4.9%	0.0%	95.1%
1000 to 1049 (Red/Green cut = 1045)	1,059	68.6%	31.4%	0.0%	69.2%
1050 to 1099	764	24.6%	75.3%	0.0%	75.3%
1100 to 1149	425	3.2%	95.8%	1.0%	95.8%
1150 to 1199	170	0.1%	88.0%	11.9%	88.0%
1200 to 1249 (Green/Blue cut = 1218)	44	0.0%	48.1%	51.9%	62.7%
1250 to 1299	9	0.0%	9.8%	90.2%	90.2%
1300 to 1349	8	0.0%	0.9%	99.1%	99.1%
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	6,302				

* Retest assuming no additional instruction

Table E–60. Retest Classification Percent for Various Scale Score Ranges – Writing Grade 3

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	11	>99.9%	0.0%	0.0%	>99.9%
300 to 349	45	>99.9%	0.0%	0.0%	>99.9%
350 to 399	153	>99.9%	0.0%	0.0%	>99.9%
400 to 449	282	>99.9%	0.0%	0.0%	>99.9%
450 to 499	280	>99.9%	0.0%	0.0%	>99.9%
500 to 549	247	>99.9%	0.0%	0.0%	>99.9%
550 to 599	263	>99.9%	0.0%	0.0%	>99.9%
600 to 649	254	>99.9%	0.0%	0.0%	>99.9%
650 to 699	280	99.4%	0.6%	0.0%	99.4%
700 to 749	367	90.5%	9.5%	0.0%	90.5%
750 to 799 (Red/Green cut = 780)	393	53.5%	46.5%	0.0%	62.4%
800 to 849	399	14.3%	85.6%	0.1%	85.6%
850 to 899	333	1.3%	95.9%	2.7%	95.9%
900 to 949	193	0.0%	77.7%	22.2%	77.7%
950 to 999 (Green/Blue cut = 953)	104	0.0%	32.9%	67.1%	67.5%
1000 to 1049	43	0.0%	6.1%	93.9%	93.9%
1050 to 1099	20	0.0%	0.3%	99.7%	99.7%
1100 to 1149	2	0.0%	0.0%	>99.9%	>99.9%
1150 to 1199	0	N/A	N/A	N/A	N/A
1200 to 1249	0	N/A	N/A	N/A	N/A
1250 to 1299	0	N/A	N/A	N/A	N/A
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	3,669				

* Retest assuming no additional instruction

Table E–61. Retest Classification Percent for Various Scale Score Ranges – Writing Grade 4

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	2	>99.9%	0.0%	0.0%	>99.9%
300 to 349	14	>99.9%	0.0%	0.0%	>99.9%
350 to 399	52	>99.9%	0.0%	0.0%	>99.9%
400 to 449	162	>99.9%	0.0%	0.0%	>99.9%
450 to 499	261	>99.9%	0.0%	0.0%	>99.9%
500 to 549	242	>99.9%	0.0%	0.0%	>99.9%
550 to 599	266	>99.9%	0.0%	0.0%	>99.9%
600 to 649	266	>99.9%	0.0%	0.0%	>99.9%
650 to 699	317	>99.9%	0.0%	0.0%	>99.9%
700 to 749	351	99.9%	0.1%	0.0%	99.9%
750 to 799	448	96.6%	3.4%	0.0%	96.6%
800 to 849	495	73.4%	26.6%	0.0%	73.4%
850 to 899 (Red/Green cut = 852)	548	28.8%	71.1%	0.0%	71.2%
900 to 949	521	4.2%	95.0%	0.8%	95.0%
950 to 999	282	0.2%	89.7%	10.1%	89.7%
1000 to 1049 (Green/Blue cut = 1025)	131	0.0%	53.1%	46.9%	62.5%
1050 to 1099	56	0.0%	16.0%	84.0%	84.0%
1100 to 1149	10	0.0%	1.3%	98.7%	98.7%
1150 to 1199	0	N/A	N/A	N/A	N/A
1200 to 1249	0	N/A	N/A	N/A	N/A
1250 to 1299	0	N/A	N/A	N/A	N/A
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	4,424				

* Retest assuming no additional instruction

Table E–62. Retest Classification Percent for Various Scale Score Ranges – Writing Grade 5

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	1	>99.9%	0.0%	0.0%	>99.9%
300 to 349	5	>99.9%	0.0%	0.0%	>99.9%
350 to 399	22	>99.9%	0.0%	0.0%	>99.9%
400 to 449	83	>99.9%	0.0%	0.0%	>99.9%
450 to 499	166	>99.9%	0.0%	0.0%	>99.9%
500 to 549	219	>99.9%	0.0%	0.0%	>99.9%
550 to 599	263	>99.9%	0.0%	0.0%	>99.9%
600 to 649	277	>99.9%	0.0%	0.0%	>99.9%
650 to 699	346	>99.9%	0.0%	0.0%	>99.9%
700 to 749	416	>99.9%	0.0%	0.0%	>99.9%
750 to 799	495	99.9%	0.1%	0.0%	99.9%
800 to 849	610	96.3%	3.7%	0.0%	96.3%
850 to 899	727	71.8%	28.2%	0.0%	71.8%
900 to 949 (Red/Green cut = 900)	713	27.7%	72.2%	0.0%	72.2%
950 to 999	632	4.0%	95.2%	0.8%	95.2%
1000 to 1049	373	0.2%	88.7%	11.1%	88.7%
1050 to 1099 (Green/Blue cut = 1073)	182	0.0%	52.8%	47.2%	62.5%
1100 to 1149	55	0.0%	14.2%	85.8%	85.8%
1150 to 1199	13	0.0%	1.2%	98.8%	98.8%
1200 to 1249	3	0.0%	0.0%	>99.9%	>99.9%
1250 to 1299	1	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	5,602				

* Retest assuming no additional instruction

Table E–63. Retest Classification Percent for Various Scale Score Ranges – Writing Grade 6

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	1	>99.9%	0.0%	0.0%	>99.9%
400 to 449	6	>99.9%	0.0%	0.0%	>99.9%
450 to 499	67	>99.9%	0.0%	0.0%	>99.9%
500 to 549	171	>99.9%	0.0%	0.0%	>99.9%
550 to 599	343	>99.9%	0.0%	0.0%	>99.9%
600 to 649	432	>99.9%	0.0%	0.0%	>99.9%
650 to 699	496	>99.9%	0.0%	0.0%	>99.9%
700 to 749	524	>99.9%	0.0%	0.0%	>99.9%
750 to 799	621	>99.9%	0.0%	0.0%	>99.9%
800 to 849	742	99.7%	0.3%	0.0%	99.7%
850 to 899	992	93.6%	6.4%	0.0%	93.6%
900 to 949 (Red/Green cut = 938)	1,178	61.7%	38.3%	0.0%	65.1%
950 to 999	1,234	18.3%	81.6%	0.0%	81.6%
1000 to 1049	918	1.7%	96.9%	1.4%	96.9%
1050 to 1099	587	0.0%	83.2%	16.7%	83.2%
1100 to 1149 (Green/Blue cut = 1111)	294	0.0%	40.3%	59.7%	63.5%
1150 to 1199	128	0.0%	7.0%	93.0%	93.0%
1200 to 1249	50	0.0%	0.4%	99.6%	99.6%
1250 to 1299	15	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	2	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	8,801				

* Retest assuming no additional instruction

Table E–64. Retest Classification Percent for Various Scale Score Ranges – Writing Grade 7

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	1	>99.9%	0.0%	0.0%	>99.9%
400 to 449	11	>99.9%	0.0%	0.0%	>99.9%
450 to 499	43	>99.9%	0.0%	0.0%	>99.9%
500 to 549	221	>99.9%	0.0%	0.0%	>99.9%
550 to 599	443	>99.9%	0.0%	0.0%	>99.9%
600 to 649	534	>99.9%	0.0%	0.0%	>99.9%
650 to 699	558	>99.9%	0.0%	0.0%	>99.9%
700 to 749	649	>99.9%	0.0%	0.0%	>99.9%
750 to 799	724	>99.9%	0.0%	0.0%	>99.9%
800 to 849	878	>99.9%	0.0%	0.0%	>99.9%
850 to 899	1,078	99.1%	0.9%	0.0%	99.1%
900 to 949	1,397	87.7%	12.3%	0.0%	87.7%
950 to 999 (Red/Green cut = 974)	1,558	48.3%	51.7%	0.0%	62.9%
1000 to 1049	1,500	10.2%	89.7%	0.1%	89.7%
1050 to 1099	1,168	0.7%	96.2%	3.2%	96.2%
1100 to 1149 (Green/Blue cut = 1147)	670	0.0%	74.0%	26.0%	74.1%
1150 to 1199	314	0.0%	28.4%	71.6%	71.6%
1200 to 1249	120	0.0%	3.7%	96.3%	96.3%
1250 to 1299	41	0.0%	0.2%	99.8%	99.8%
1300 to 1349	8	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	1	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	11,917				

* Retest assuming no additional instruction

Table E–65. Retest Classification Percent for Various Scale Score Ranges – Writing Grade 8

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	1	>99.9%	0.0%	0.0%	>99.9%
450 to 499	33	>99.9%	0.0%	0.0%	>99.9%
500 to 549	193	>99.9%	0.0%	0.0%	>99.9%
550 to 599	460	>99.9%	0.0%	0.0%	>99.9%
600 to 649	629	>99.9%	0.0%	0.0%	>99.9%
650 to 699	607	>99.9%	0.0%	0.0%	>99.9%
700 to 749	637	>99.9%	0.0%	0.0%	>99.9%
750 to 799	710	>99.9%	0.0%	0.0%	>99.9%
800 to 849	774	>99.9%	0.0%	0.0%	>99.9%
850 to 899	895	99.6%	0.4%	0.0%	99.6%
900 to 949	1,204	92.5%	7.5%	0.0%	92.5%
950 to 999 (Red/Green cut = 985)	1,373	58.6%	41.4%	0.0%	63.9%
1000 to 1049	1,566	15.9%	84.1%	0.0%	84.1%
1050 to 1099	1,295	1.4%	96.9%	1.7%	96.9%
1100 to 1149	683	0.0%	81.2%	18.8%	81.2%
1150 to 1199 (Green/Blue cut = 1158)	312	0.0%	36.3%	63.7%	65.8%
1200 to 1249	115	0.0%	5.3%	94.7%	94.7%
1250 to 1299	48	0.0%	0.3%	99.7%	99.7%
1300 to 1349	14	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	4	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	11,553				

* Retest assuming no additional instruction

Table E–66. Retest Classification Percent for Various Scale Score Ranges – English Composition

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	1	>99.9%	0.0%	0.0%	>99.9%
400 to 449	3	>99.9%	0.0%	0.0%	>99.9%
450 to 499	34	>99.9%	0.0%	0.0%	>99.9%
500 to 549	158	>99.9%	0.0%	0.0%	>99.9%
550 to 599	365	>99.9%	0.0%	0.0%	>99.9%
600 to 649	461	>99.9%	0.0%	0.0%	>99.9%
650 to 699	424	>99.9%	0.0%	0.0%	>99.9%
700 to 749	380	>99.9%	0.0%	0.0%	>99.9%
750 to 799	329	>99.9%	0.0%	0.0%	>99.9%
800 to 849	333	>99.9%	0.0%	0.0%	>99.9%
850 to 899	422	99.8%	0.2%	0.0%	99.8%
900 to 949	510	95.0%	5.0%	0.0%	95.0%
950 to 999 (Red/Green cut = 994)	588	66.4%	33.6%	0.0%	67.2%
1000 to 1049	701	22.0%	78.0%	0.0%	78.0%
1050 to 1099	697	2.4%	96.6%	1.0%	96.6%
1100 to 1149	403	0.1%	86.4%	13.5%	86.4%
1150 to 1199 (Green/Blue cut = 1167)	232	0.0%	45.9%	54.1%	62.1%
1200 to 1249	92	0.0%	8.9%	91.1%	91.1%
1250 to 1299	69	0.0%	0.6%	99.4%	99.4%
1300 to 1349	20	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	5	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	1	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	6,228				

* Retest assuming no additional instruction

APPENDIX F: CDT LEARNING PROGRESSIONS

The CDT learning progressions were developed by the Pennsylvania Department of Education (PDE) and its curriculum consultants, including staff from Data Recognition Corporation (DRC), to show the developmental sequences or building blocks of content/skills students need to master as they progress toward career and college readiness. The progressions were developed for each content area (i.e., English language arts, mathematics, and science.) They served and continue to serve as roadmaps or the pathways (K-12) that students travel as they progress toward mastery of the skills needed for career and college readiness. As such, each learning progression was developed to provide teachers with the opportunity to determine whether students have navigated successfully through the building blocks and are able to move forward along the road to career and college readiness for a given content area. Each progression also provides teachers with the opportunity to identify students who may need additional instruction in a given content area, as well as to identify students who have navigated successfully beyond the building blocks or mileposts for each grade and/or course and are in need of accelerated curriculum. The learning progressions are directly aligned and based upon the Pennsylvania Academic Standards, the Assessment Anchors, and the Eligible Contents and as such provide evidence of the linkage between the CDT and the Pennsylvania PSSA and Keystone assessments addressing career and college readiness success with interpretations.

The learning progressions were first developed in 2009. Upon the initial development of the learning progression, the progressions were reviewed by Pennsylvania educators to confirm alignment to the Pennsylvania Standards and to confirm that the progressions, do, in fact, serve to show the development sequences of content/skills students need to master as they progress toward career and college readiness. At this meeting with educators, PDE and DRC provided information about the development of the learning progressions, the purpose of the progressions, and the actual progressions for each content area. The committees of Pennsylvania educators reviewed the progressions, which serve to show the vertical articulation of the Pennsylvania Academic Standards, Assessment Anchors and Eligible Content across grades within a given subject area (e.g., reading, mathematics). Pennsylvania educators were asked to confirm that the progressions were an accurate representation of how the content/skills included in the Pennsylvania Academic Standards progressed across grades and provided a broad description of the essential content and general sequencing for student learning and skill development as each student progresses toward college and career readiness.

Beginning 2010, the learning progressions have continued to be used during item reviews for the CDT, as well as for the PSSA and the Keystone assessments. For example, during each subsequent review of items for potential use on these assessments, including the CDT, Pennsylvania educators, in addition to reviewing items for alignment to the standards, cognitive complexity, technical quality, etc. also review items for alignment to the learning progressions. The learning progressions are included in this evidence to demonstrate the content/skills linkage between the CDT to address career and college readiness success.

APPENDIX G: DEVELOPMENT OF THE PENNSYLVANIA ACADEMIC STANDARDS, ASSESSMENT ANCHOR CONTENT STANDARDS, AND ELIGIBLE CONTENT

The Assessment Anchor Content Standards and Eligible Content statements are based on the Pennsylvania Academic Standards in English language arts and mathematics and the Pennsylvania Academic Standards in science. Although the Academic Standards indicated in broad terms what students should know and be able to do, educator concerns regarding the number and breadth of the Academic Standards led to an initiative by the Pennsylvania Department of Education (PDE) to develop Assessment Anchor Content Standards to indicate which parts of the Academic Standards (Instructional Content Standards) would be assessed on the summative assessments. Based on recommendations from Pennsylvania educators, the Assessment Anchor Content Standards were designed to improve the articulation of curricular, instructional, and assessment practices. The anchors clarify what is expected across each grade and content area and focus the content of the standards into what is assessable on a large-scale test. The Assessment Anchor Content Standards also serve to communicate Eligible Content or assessment limits. The Eligible Content statements also provide for the range of knowledge and skills from which the summative assessments and the CDT is designed.

The Assessment Anchor Content Standards' structure includes the content, grade level, Reporting Category, Assessment Anchor, descriptor (Sub-Assessment Anchor), and Eligible Content. Each of the Assessment Anchor Content Standards has one or more descriptors (Sub-Assessment Anchors) and Eligible Content to reflect grade-level appropriateness. The Assessment Anchor Content Standards form the basis of the test design. In turn, this hierarchy is the basis for organizing the total content scores (based on the core [common] sections). The Assessment Anchor Content Standards, therefore, are the general descriptions of what students should know and be able to do. The Eligible Content statements are the more specific statements of the knowledge and/or skills that students are expected to demonstrate in a given grade and content area. The Eligible Content statements are considered the granular level to which items are written. As such, they serve to define at a more granular level what students should know and be able to do. They also serve as the checkpoints that monitor progress toward meeting the board Pennsylvania Academic Standards. In other states' structures of content standards, the Assessment Anchor Content Standards are often labeled Benchmarks, and the Eligible Content statements are often labeled grade-level expectations.

The complete set of Assessment Anchor Content Standards and Eligible Content statements aligned to the board Pennsylvania Academic Standards can be found at the PDE's website: www.education.pa.gov.

DEVELOPMENT OF THE ASSESSMENT ANCHOR CONTENT STANDARDS AND THE ELIGIBLE CONTENT STATEMENTS

With Pennsylvania's decision to adopt the Pennsylvania Academic Standards in July 2010, committees of Pennsylvania educators then met in October 3–6, 2011 to write and review the Assessment Anchor Content Standards and Eligible Content statements aligned to the new Pennsylvania Academic Standards. Members of the committees included representatives from the PDE curriculum and instruction, the PDE assessment, Pennsylvania educators, and a team of expert consultants appointed by the PDE. The consultants were Pennsylvania known and nationally known experts representing specific areas of expertise. These appointed consultants were members of the Pennsylvania Quality Review Team, and their function was to oversee the process, ensuring quality throughout.

Prior to the beginning of the development of the Assessment Anchor Content Standards and the Eligible Content statements, the PDE-selected Quality Review Team consultants and the PDE assessment and curriculum staff analyzed pertinent national career- and college-ready standards and curriculum framework documents including frameworks from the National Assessment of Educational Progress (NAEP). Once the analysis was completed, members of the PDE-selected Quality Review Team met with the testing vendor, Data Recognition Corporation (DRC) to provide recommendations as to what materials and documents would be needed to facilitate the committees of Pennsylvania educators in the development and review of the Assessment Anchor Content Standards and the Eligible Content statements. In addition, the purpose of this meeting with the Quality Review Team was to come to agreement on the Assessment Anchor Content Standards and Eligible Content development process, including the role of the Pennsylvania educators, the PDE assessment staff, the PDE curriculum staff, the Quality Review Team members, and the testing vendor, DRC.

To provide initial focus at the October 2011 meetings, each content and grade committee of Pennsylvania educators was presented with materials specific to the content and grade to which the anchors and Eligible Content statements were to be developed, including a basic blueprint structure of the summative assessment and the CDT. The Pennsylvania Academic Standards, the 2005 version of the Pennsylvania Assessment Anchor Content Standards and Eligible Content aligned to the previous Pennsylvania Academic Standards, other career- and college-ready state standards, and draft Eligible Content statements aligned to the newly revised Pennsylvania Academic Standards were also provided. Committees then completed an iterative process of developing, reviewing, and revising the Assessment Anchor Content Standards and Eligible Content statements followed by discussions across grade-level committees to ensure vertical articulation across the grades. The results from the committee work were recorded and eventually evaluated by national, state, and local subject experts as noted in the sections below.

To begin the process, a general training session was held for all meeting participants. The training included welcome remarks, setting of the context for the task by the PDE staff and the PDE Quality Review Team member staff, and a presentation of the procedural training and meeting logistics by the testing vendor, DRC. Each meeting began with an introduction to Pennsylvania's Standards Aligned System and an overview of the assessment program. The PDE staff and the PDE Quality Review Team members articulated Pennsylvania's vision for the content standards, including the role that the Assessment Anchor Content Standards and Eligible Content statements would play in defining what students should know and be able to do. The opening presentation also included providing educators with the definition, structure, and purpose of the content standards, including definitions of Assessment Anchor Content Standards and Eligible Content statements. Training was also provided concerning writing, reviewing, and revising the Assessment Anchor Content Standards and Eligible Content statements. The focus of the training was to follow the design parameters to include clear, focused, rigorous, manageable, and subject-area statements.

The following materials were provided at the meeting:

- Pennsylvania Curriculum Framework: The Curriculum Framework specifies what is to be taught for each subject in the curriculum. In Pennsylvania, Curriculum Frameworks include Big Ideas, Concepts, Competencies, and Essential Questions aligned to standards. They are defined as follows:

  Big Ideas: The big ideas are the declarative statements that describe concepts that transcend grade levels. Big Ideas are essential to provide focus on specific content for all students.

  Concepts: The concepts are what students should know (key knowledge) as a result of this instruction specific to grade level.

  Competencies: The competences are what students should be able to do (key skills) as a result of this instruction, specific to grade level.

  Essential Questions: The essential questions are connected to the Standards Aligned System (SAS) framework and are specifically linked to the big ideas. They frame student inquiry, promote critical thinking, and assist in learning transfer.

- Pennsylvania Academic Standards

- Other documents as relevant, including hard copy working documents with adequate white space

After the training, committee members were instructed to begin the development process. Committee members were provided with hard copy working documents. Using their background knowledge and the materials they were provided during the meeting (e.g., documents from the Standards Aligned System, curriculum framework, Pennsylvania's Academic Standards), Pennsylvania educators created their own short list of the critical concepts that Pennsylvania students must know and be able to do for each grade and content area. Beginning with one concept at a time, concepts or Eligible Content statements were recorded on the master list; Assessment Anchor Content Standards were then developed and reviewed. As the Assessment Anchor Content Standards and Eligible Content statements were developed, they were displayed using a laptop and projector. A scribe from the testing vendor, DRC, served to record the committee members' work as well as other comments. The scribe also recorded changes or additions to the anchors and/or statements as directed from the consensus of the group.

Next, the entire group reviewed and discussed the recommendations for the anchors and the Eligible Content statements. Consensus was reached. The committee of Pennsylvania educators proceeded in this manner until all Assessment Anchor Content Standards and Eligible Content statements for each grade and content area were developed, reviewed, and discussed. DRC's facilitator took notes verbatim regarding the intent and direction of the committee. The notes were prepared for use in subsequent meetings.

FOLLOW-UP MEETINGS WITH THE QUALITY REVIEW TEAM AND PDE

A series of follow-up meetings took place with the PDE-appointed team of consultants, PDE assessment staff, and PDE-appointed Quality Review Team members. Prior to the follow-up meetings, a draft of the Assessment Anchor Content Standards and Eligible Content statements for each grade and content area were prepared for review, including all notes from the meeting with Pennsylvania educators. During the follow-up meetings, the Assessment Anchor Content Standards and Eligible Content statements were reviewed, and revisions were suggested. After the follow-up meetings, the Assessment Anchor Content Standards and Eligible Content statements were revised by the PDE and the PDE Quality Review Team per agreed-upon feedback. This revised draft was then posted on the Pennsylvania System of Aligned Standards (SAS) website for public review and opinion. All additional feedback from the public review was reviewed again by the PDE and the PDE-appointed Quality Review Team and agreed upon revisions to the Assessment Anchor Content Standards and Eligible Content statements were made. The Assessment Anchor Content Standards and Eligible Content statements were then finalized and prepared for the Pennsylvania Board of Education for approval as the official Pennsylvania Academic Content Standards.

PENNSYLVANIA BOARD OF EDUCATION APPROVAL

The Assessment Anchor Content Standards and Eligible Content statements were presented to the State Board of Education in September 2013. They were subsequently approved by the State Board at the September 2013 State Board meeting as Pennsylvania Content Standards.

APPENDIX H: CDT PASSAGE DEVELOPMENT PROCESS

The task of writing passages or securing passages and or other stimuli for the CDT is conducted by Data Recognition Corporation (DRC) professionals with classroom experience in reading/language arts as well as experience writing the various types of passages and/or stimuli required by the CDT and the Pennsylvania Academic Standards, Assessment Anchors, and Eligible Content. Guidelines provided to writers for passage/stimulus writing for the CDT include appropriate length, text structure, density, and vocabulary for the grade level as reviewed and approved by the Pennsylvania Department of Education (PDE) and as aligned to the Pennsylvania Academic Standards, Assessment Anchors, and Eligible Content. Passage/stimulus writers are given a specified number of passages/stimuli to write for each genre/standard per grade. Passage/stimulus training includes training writers to develop passages/stimuli to meet the following requirements:

- Grade appropriateness
- Appropriate readability for the assigned grade
- Interest value for students
- Freedom from bias, fairness, and sensitivity issues
- Representation of different cultures
- Ability to generate a variety of item types
- Avoidance of dated subject matter, unless a relevant historical context is provided
- No need for extensive background knowledge in a certain discipline or subject area

While DRC does train passage writers to be knowledgeable of each passage's readability, for the CDT we also statistically analyze readability of each passage, using Lexile, Flesch-Kincaid, Powers, and Spache measurements. The process that DRC's item and test development team uses to determine text complexity involves (1) the quantitative evaluation of the text, and (2) the qualitative evaluation of the text. This analysis is documented on a passage placemat. (See example passage placemat at the end of this section.) A third component, matching reader to text and task, is also taken into consideration during passage evaluation and internal reviews.

QUANTITATIVE EVALUATION

Evaluating the complexity of a passage is a judgment process conducted by DRC passage writers and internal reviewers who are familiar with the classroom context and what is developmentally and linguistically appropriate for students at a given grade level. DRC uses common readability formulas along with the qualitative information when selecting passages during development.

QUALITATIVE EVALUATION

For programs such as the CDT, DRC also implements qualitative measures to help determine placement and appropriateness of passages. These measures include rubric-based qualitative evaluations and external reviewers to provide expert opinions on grade-level appropriateness, as part of considerations for matching the reader to text and task. Rubrics provide the qualitative measures for literary and informational passages. As indicated on the placemats, the quantitative rubrics suggest the appropriate grade band of the passage, while the qualitative rubrics help to further clarify the specific grade level of the passage. These rubrics provide a powerful and comprehensive way of evaluating a range of stimulus materials that cover the literary and informational scope outlined in the client state's standards.

TEXT COMPLEXITY: QUALITATIVE-MEASURES RUBRIC—LITERARY TEXTS

The English Language Arts State Collaborative on Assessment and Student Standards (SCASS) developed the following qualitative-measures rubric for determining the text complexity of literary passages. The rubric examines criteria judged as central to students' successful comprehension of text meaning, text structure, language features, and knowledge demands. Each of these categories is ranked based on descriptors associated with the following levels: slightly complex, moderately complex, very complex, and exceedingly complex.

Qualitative-Measures Rubric—Literary Passages

Features	Exceedingly Complex	Very Complex	Moderately Complex	Slightly Complex
Meaning	Several levels and competing elements of meaning that are difficult to identify, separate, and interpret; theme is implicit or subtle, often ambiguous and revealed over the entirety of the text	Several levels of meaning that may be difficult to identify or separate; theme is implicit or subtle and may be revealed over the entirety of the text	More than one level of meaning with levels clearly distinguished from each other; theme is clear but may be conveyed with some subtlety	One level of meaning; theme is obvious and revealed early in the text
Organization	Organization is intricate with regard to elements such as narrative viewpoint, time shifts, multiple characters, storylines, and detail	Organization may include subplots, time shifts, and more complex characters	Organization may have two or more storylines and is occasionally difficult to predict	Organization of text is clear, chronological, or easy to predict
Use of images	If used, minimal illustrations that support the text	If used, a few illustrations that support the text	If used, a range of illustrations that support selected parts of the text	If used, extensive illustrations that directly support and assist in interpreting the written text
Language Features	**Conventionality**	**Conventionality**	**Conventionality**	**Conventionality**
	Dense and complex; contains abstract, ironic, and/or figurative language	Complex; contains some abstract, ironic, and/or figurative language	Largely explicit and easy to understand, with some occasions for more complex meaning	Explicit, literal, straightforward, easy to understand
	Vocabulary	**Vocabulary**	**Vocabulary**	**Vocabulary**
	Generally unfamiliar, archaic, subject- specific, or overly academic language; may be ambiguous or purposefully misleading	Somewhat complex language that is sometimes unfamiliar, archaic, subject- specific, or overly academic	Mostly contemporary, familiar, conversational; rarely unfamiliar or overly academic	Contemporary, familiar, conversational language
	Sentence Structure	**Sentence Structure**	**Sentence Structure**	**Sentence Structure**
	Mainly complex sentences, often containing multiple concepts	Many complex sentences with several subordinate phrases or clauses and transition words	Simple and compound sentences, with some more complex constructions	Mainly simple sentences
Knowledge Demands	**Life Experiences**	**Life Experiences**	**Life Experiences**	**Life Experiences**
	Explores complex, sophisticated themes; experiences are distinctly different from those of the common reader	Explores themes of varying levels of complexity; experiences portrayed are uncommon to most readers	Explores a single theme; experiences portrayed are common to many readers	Explores a single theme; experiences portrayed are everyday and common to most readers
	Intertextuality and Cultural Knowledge	**Intertextuality and Cultural Knowledge**	**Intertextuality and Cultural Knowledge**	**Intertextuality and Cultural Knowledge**
	Many references or allusions to other texts or cultural elements	Some references or allusions to other texts or cultural elements	A few references or allusions to other texts or cultural elements	No references or allusions to other texts or cultural elements

Qualitative-Measures Rubric—Informational Texts

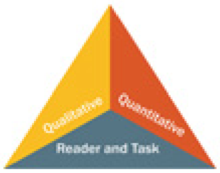
Features	Exceedingly Complex	Very Complex	Moderately Complex	Slightly Complex
Purpose	**Purpose** Subtle, implied, difficult to determine; intricate, theoretical elements	**Purpose** Implied but fairly easy to infer; more theoretical than concrete	**Purpose** Implied but easy to identify based upon context or source	**Purpose** Explicitly stated; clear, concrete with a narrow focus
Text Structure	**Organization of Main Ideas** Connections between an extensive range of ideas, processes, or events are deep and often implicit or subtle; organization of the text is intricate or specialized for a particular discipline	**Organization of Main Ideas** Connections between an expanded range of ideas, processes, or events are deeper and often implicit or subtle; organization may contain multiple pathways and may exhibit traits common to a specific discipline	**Organization of Main Ideas** Connections between some ideas or events are implicit or subtle; organization is evident and generally sequential	**Organization of Main Ideas** Connections between ideas, processes, or events are explicit and clear; organization of text is clear or chronological or easy to predict
	Text Features If used, are essential in understanding content	**Text Features** If used, greatly enhance the reader's understanding of content	**Text Features** If used, enhance the reader's understanding of content	**Text Features** If used, help the reader navigate and understand content but are not essential
	Use of Images If used, extensive, intricate, essential integrated images, tables, charts, etc., necessary to make meaning of text; also may provide information not otherwise conveyed in the text	**Use of Images** If used, essential integrated images, tables, charts, etc., may occasionally be essential to understanding the text	**Use of Images** If used, images such as indexes and glossaries are mostly supplementary to understanding of the text; graphs, pictures, tables, and charts directly support the text	**Use of Images** If used, images are simple and unnecessary to understanding the text but directly support and assist in interpreting the written text
Language Features	**Conventionality** Dense and complex; contains abstract, ironic, and/or figurative language	**Conventionality** Complex; contains some abstract, ironic, and/or figurative language	**Conventionality** Largely explicit and easy to understand, with some occasions for more complex meaning	**Conventionality** Explicit, literal, straightforward, easy to understand
	Vocabulary Generally unfamiliar, archaic, subject- specific, or overly academic language; may be ambiguous or purposefully misleading	**Vocabulary** Somewhat complex language that is sometimes unfamiliar, archaic, subject-specific, or overly academic	**Vocabulary** Mostly contemporary, familiar, conversational; rarely unfamiliar or overly academic	**Vocabulary** Contemporary, familiar, conversational language
	Sentence Structure Mainly complex sentences, often containing multiple concepts	**Sentence Structure** Many complex sentences with several subordinate phrases or clauses and transition words	**Sentence Structure** Simple and compound sentences, with some more complex constructions	**Sentence Structure** Mainly simple sentences
Knowledge Demands	**Subject Matter Knowledge** Extensive, perhaps specialized or even theoretical discipline-specific content knowledge; range of challenging abstract and theoretical concepts	**Subject Matter Knowledge** Moderate levels of discipline-specific content knowledge; some theoretical knowledge may enhance understanding; range of recognizable ideas and challenging abstract concepts	**Subject Matter Knowledge** Everyday practical knowledge and some discipline-specific content knowledge; both simple and more complicated, abstract ideas	**Subject Matter Knowledge** Everyday, practical knowledge; simple, concrete ideas
	Intertextuality Many references or allusions to other texts or outside ideas, theories, etc.	**Intertextuality** Some references or allusions to other texts or outside ideas, theories, etc.	**Intertextuality** A few references or allusions to other texts or outside ideas, theories, etc.	**Intertextuality** No references or allusions to other texts, or outside ideas, theories, etc.

Adapted from Smarter Balanced and © 2012 by the ELA SCASS

Passage Placemat

Below is an example of a passage placemat for item writer use.

Worksheet: Text Complexity Analysis		
Title	**Author**	**Text Description**



Recommended Placement for Assessment: Grade X

Qualitative Measures

PURPOSE

:

TEXT STRUCTURE

Organization of Main Ideas:

: **Text Features:**

N/A

Use of Images:

N/A

LANGUAGE FEATURES

Conventionality:

:

Vocabulary:

:

Sentence Structure:

:

KNOWLEDGE DEMANDS

Subject Matter Knowledge:

:

Intertextuality:

:

Quantitative Measures

Common Core State Standards Appendix A Complexity Band Level (if applicable):

Lexile or Other Quantitative Measure of the Text

Lexile:

Flesch-Kincaid:

Considerations for Passage Selection

Passage selection should be based on the ELA Content Specifications targets and the cognitive demands of the assessment tasks.

Potential Challenges This Text May Pose (check all that apply):

	Accessibility
	Sentence and text structures
	Archaic language, slang, idioms, or other language challenges
	Background knowledge
	Bias and sensitivity issues
	Word count

Adapted from Smarter Balanced and the 2012 ELA SCASS work

REFERENCES

Allman, C. (2004). *Test access: Making tests accessible for students with visual impairments – A guide for test publishers, test developers, and state assessment personnel* (2nd edition). Louisville, KY: American Printing House for the Blind. Available from http://www.aph.org.

Alonzo, A.C. & Gearhart, M. (2006). Considering learning progressions from a classroom assessment perspective. Measurement: Interdisciplinary Research and Perspectives. Vol. 4(1&2) Mahwah, NJ: Lawrence Erlbaum. 99-108.

Angoff, W. H. (1984). Scales, norms, and equivalent scores. Princeton NJ: Educational Testing Service. [Reprint of chapter in R. L. Thorndike (Ed.), *Educational Measurement* (2nd ed.) (pp. 508–600). Washington, DC: American Council on Education, 1971.]

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

Black, P. & Wiliam, D. (2004). The formative purpose: Assessment must first promote learning. In M. Wilson (ed.), Towards Coherence between Classroom Assessment and Accountability. 103RF Yearbook of the National Society for the Study of Education, Part 2. Chicago, IL: National Society for the Study of Education. 20-50.

Cronbach, L. J. (1971). Test validation. In R. L. Thorndike (Ed.), *Educational Measurement* (2nd ed., p. 443–507). Washington, DC: American Council on Education.

Cronbach, L., & Shavelson R. L. (2004). My current thoughts on coefficient alpha and successor procedures. *Educational and Psychological Measurement*, 64(3), 391–418.

Data Recognition Corporation. (2003–2010). *Fairness in Testing: Training Manual for Issues of Bias, Fairness, and Sensitivity*. Maple Grove, MN: DRC.

Dorans, N., Schmitt, A., & Bleistein, C. (1992). The standardization approach to assessing comprehensive differential item functioning. *Journal of Educational Measurement*, *29*, 309–319.

Eignor, D. R. (1985). An investigation of the feasibility and practical outcomes of preequating the SAT verbal and mathematical sections. (Research Report 85–10). Princeton, NJ: Educational Testing Service.

Eignor, D. R., & Stocking, M. L. (1986). An investigation of the possible causes for the inadequacy of IRT preequating. (Research Report 86–14). Princeton, NJ: Educational Testing Service.

Frisbie, D. A. (2005). Measurement 101: Some fundamentals revisited. *Educational Measurement: Issues and Practice*, 24(3) 21–28.

Gong, B. (2008). Developing Learning Progressions to inform Formative Assessment: Five areas to develop. Presentation at the CCSSO FAST SCASS Meeting, February 6, 2008, Atlanta, GA. Center for Assessment

Gulliksen, H. (1950). *Theory of mental tests*. New York: John Wiley and Sons.

Hambleton, R., & Novick, M. (1973). Toward an integration of theory and method for criterion-referenced tests. *Journal of Educational Measurement*, 10, 159–170.

Hanson, B. A., & Brennan, R. L. (1990). An investigation of classification consistency indexes estimated under alternative strong true score theory models. *Journal of Educational Measurement*, 27(4), 345–359.

Harvill, L. M., (1991). Standard error of measurement. *Educational Measurement: Issues and Practices*, 10(2), 33–41.

Hess, K. (2008). Developing and Using Learning Progressions as a Schema for Measuring Progress National Center for the Improvement of Educational Assessment, Dover, New Hampshire

Hess, K. (2008). Tools and Strategies for Developing and Using Learning Progressions. Five areas to develop. Presentation at the CCSSO FAST SCASS Meeting, February 6, 2008, Atlanta, GA. Center for Assessment

Heritage, M. (2008). Learning Progressions: Supporting Instruction and Formative Assessment. National Center for Research on Evaluation, Standards, and Student Tests (CRESST) paper prepared for the Formative Assessment for Teachers and Students (FAST) State Collaborative on Assessment and Student Standards (SCASS) of the Council of Chief State School Officers (CCSS)

Huynh, H. (1976). On the reliability of decisions in domain referenced testing. *Journal of Educational Measurement*, 13, 253–264.

Kolen, M. J., & Brennan, R. L. (2004). Test equating, scaling, and linking. New York, NY: Springer.

Kolen, M. J., & Harris, D. J. (1990). Comparison of item preequating and random groups equating using IRT and equipercentile methods. *Journal of Educational Measurement*, 27, No. 1 (Spring), pp. 27–39.

Lane, S. (1999). *Validity evidence for assessments*. Paper presented at the 1999 Edward F. Reidy Interactive Lecture Series, Providence, RI.

Lane, S., & Stone, C. A. (2002). Strategies for examining the consequences of assessment and accountability programs. *Educational Measurement: Issues and Practice*, 21(1), 23–30.

Leung, C. K., Chang, H. H., & Hau, K. T. (2003). Computerized adaptive testing: A comparison of three content balancing methods. Journal of Technology, Learning, and Assessment, 2(5).

Linacre, J. M. (2009). *A user's guide to WINSTEPS MININSTEP Rasch-model computer programs*. Chicago, IL: Winsteps.

Linacre, J. M. (2009). *WINSTEPS 3.71: Multiple-choice, rating scale, and partial credit Rasch analysis* [computer software]. Chicago: MESA Press.

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

Mantel, N. & Haenszel, W. (1959). Statistical aspects of the analysis of data from retrospective studies of disease. *Journal of the National Cancer Institute*, 22, 719–748.

Marais, I., & Andrich, D. (2008). Formalizing dimension and response violations of local independence in the unidimensional Rasch model. *Journal of Applied Measurement*, 9(3), 200–215.

McDonald, R. P. (1979). The structural analysis of multivariate data: A sketch of general theory. *Multivariate Behavioral Research*, 14, 21–38.

Mctighe, J. and Wiggins, G.P. (2005) Understanding by Design. Alexandria, VA: Association for Supervision and Curriculum and Development.

Messick, S. (1989). Validity. In R. L. Linn (ed.), *Educational Measurement* (3rd ed., pp. 3–104). New York: American Council on Education.

Pennsylvania Department of Education. (2010). Classroom Diagnostic Tools *Results for Preliminary Benchmarking Activity – Mathematics*. Harrisburg, PA: PDE.

Pennsylvania Department of Education. (2011). Classroom Diagnostic Tools *Results for Preliminary Benchmarking Activity – Reading and Science*. Harrisburg, PA: PDE.

Pennsylvania Department of Education. (2011). Classroom Diagnostic Tools *Results for Preliminary Benchmarking Activity – Writing*. Harrisburg, PA: PDE.

Petersen, N. S., Kolen, M. J., & Hoover, H. D. (1989). Scaling, norming, and equating. In R. L. Linn (ed.), Educational measurement (3rd ed., pp. 221–262). Washington, DC: American Council on Education.

Rasch, G. (1960). *Probabilistic Models for Some Intelligence and Attainment Tests*. Copenhagen: Danish Institute for Educational Research.

Spearman, C. (1904). The proof and measurement of association between two things. *American Journal of Psychology*, 15, 72–101.

Spearman, C. (1910). Correlation calculated from faulty data. *British Journal of Psychology*, 3, 271–295.

Stearns, M., & Smith, R. M. (2007). *Estimation of classification consistency indices for complex assessments: Model based approaches*. Paper presented at the 2007 Annual Convention of the American Educational Research Association. Chicago, IL.

Stocking, M. L., & Eignor, D. R. (1986). The impact of different ability distributions on IRT preequating. (Research Report, 86–14). Princeton, NJ: Educational Testing Service.

Thompson, S., Johnstone, C. J., & Thurlow, M. L. (2002). *Universal Design Applied to Large Scale Assessments* (Synthesis Report 44), Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes.

Webb, N. L. (1999). *Research Monograph No. 18: Alignment of Science and Mathematics Standards and Assessments in Four States*. Madison, WI: National Institute for Science Education.

Webb, N. L. (2002) *Alignment study in language arts, mathematics, science, and social studies of state standards and tests for four states: State collaborative on test and state standards (SCASS)*. Madison, WI: University of Wisconsin–Madison, Wisconsin Center for Education Research.

Wright, B., & Masters, G. (1982). *Rating scale analysis*. Chicago: MESA Press.