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Nebraska State Accountability (NeSA)

Reading, Mathematics, and Science

Technical Report

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2013 NEBRASKA STATE ACCOUNTABILITY (NeSA) TECHNICAL REPORT

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1. BACKGROUND

1.1 PURPOSE AND ORGANIZATION OF THIS REPORT

This report documents the technical aspects of the 2013 Nebraska State Accountability Reading (NeSA-R), Mathematics (NeSA-M), and Nebraska Science (NeSA-S) operational tests, along with the NeSA-R, NeSA-M and NeSA-S embedded field tests, covering details of item and test development processes, administration procedures, and psychometric methods and summaries.

1.2 BACKGROUND OF THE NEBRASKA STATE ACCOUNTABILITY (NESA)

Previous Nebraska Assessments: In previous years, Nebraska administered a blend of local and state-generated assessments to meet No Child Left Behind (NCLB) requirements called STARS (School-based Teacher-led Assessment and Reporting System). STARS was a decentralized local assessment system that measured academic content standards in reading, mathematics, and science. The state reviewed every local assessment system for compliance and technical quality. The Nebraska Department of Education (NDE) provided guidance and support for Nebraska educators by training them to develop and use classroom-based assessments. For accreditation, districts were also required to administer national norm-referenced tests (NRT).

As a component of STARS, the NDE administered one writing assessment annually in grades 4, 8, and 11. In addition, the NDE provided an alternate assessment for students severely challenged by cognitive disabilities.

Purpose of the NeSA: Legislative Bill 1157 passed by the 2008 Nebraska Legislature (http://www.legislature.ne.gov/laws/statutes.php?statute=79-760.03) required a single statewide assessment of the Nebraska academic content standards for reading, mathematics, science, and writing in Nebraska's K-12 public schools. The new assessment system was named NeSA (Nebraska State Accountability), with NeSA-R for reading assessments, NeSA-M for mathematics, NeSA-S for science, and NeSA-W for writing (Complete documentation of the technical details for NeSA-W are presented in a separate document labeled *NeSA 2013 Writing Test Technical Report*). The assessments in reading and mathematics were administered in grades 3-8 and 11; science was administered in grades 5, 8, and 11.

NeSA replaced previous school-based assessments for purposes of local, state, and federal accountability. The NeSA RMS consists entirely of multiple choice items and will be administered, to the extent practicable, online. In January 2009, the NDE contracted with Data Recognition Corporation (DRC) to support the Department of Education with the administration, record keeping, and reporting of statewide student assessment and accountability.

Phase-In Schedule for NeSA: The NDE prescribed such assessments starting in the 2009-2010 school year to be phased in as shown in Table 1.2.1. The state intends to use the expertise and experience of in-state educators to participate, to the maximum extent possible, in the design and development of the new statewide assessment system.

Table 1.2.1: NeSA Administration Schedule

Subject	Administration Year		Grades
	Field Test	Operational	
Reading	2009	2010	3 through 8 plus high school
Mathematics	2010	2011	3 through 8 plus high school
Science	2011	2012	5, 8 and 11

Advisory Committees: Legislative Bill 1157 added a governor-appointed Technical Advisory Committee (TAC) with three nationally recognized experts in educational assessment, one Nebraska administrator, and one Nebraska teacher. The TAC reviewed the development plan for the NeSA, and provided technical advice, guidance, and research to help the NDE make informed decisions regarding standards, assessment, and accountability.

2. ITEM AND TEST DEVELOPMENT

2.1 CONTENT STANDARDS

In April of 2008, the Nebraska Legislature passed into state law Legislative Bill 1157. This action changed previous provisions related to standards, assessment, and reporting. Specific to standards, the legislation stated:

- The State Board of Education shall adopt measurable academic content standards for at least the grade levels required for statewide assessment. The standards shall cover the content areas of reading, writing, mathematics, science, and social studies. The standards adopted shall be sufficiently clear and measurable to be used for testing student performance with respect to mastery of the content described in the state standards.
- The State Board of Education shall develop a plan to review and update standards for each content area every five years.
- The State Board of Education shall review and update the standards in reading by July 1, 2009, the standards in mathematics by July 1, 2010, and these standards in all other content areas by July 1, 2013.

The Nebraska Language Arts Standards are the foundation for NeSA-R. This assessment instrument is comprised of items that address standards for grades 3–8 and 12. The standards are assessed at grade-level with the exception of grade 12. The grade 12 standards are assessed on the NeSA tests at grade 11. The reading standards for each grade are represented in items that are distributed between two reporting categories: Vocabulary and Comprehension. The Vocabulary standards include word structure, context clues, and semantic relationships. The Comprehension standards include author's purpose, elements of narrative text, literary devices, main idea, relevant details, text features, genre, and generating questions while reading.

The mathematics component of the NeSA is composed of items that address indicators in grades 3–8 and high school. The standards are assessed at grade level with the exception of high school. The high school standards are assessed on the NeSA-M at grade 11. The assessable standards for each grade level are distributed among the four reporting categories: Number Sense Concepts, Geometric/Measurement Concepts, Algebraic Concepts, and Data Analysis/Probability Concepts. The National Council of Teachers of Mathematics (NCTM) and the National Assessment of Educational Progress (NAEP) standards are the foundation of the Nebraska Mathematics standards.

The science component of the NeSA is composed of items that address indicators in grade-band strands 3–5, 6–8, and 9–12. The NeSA-S assesses the standards for each grade-band strand at a specific grade: 3-5 strand at grade 5, 6–8 strand at grade 8, and 9–12 strand at grade 11. The assessable standards for each grade level are distributed among the four reporting categories: Inquiry, The Nature of Science, and Technology; Physical Science; Life Science; and Earth and Space Sciences.

2.2 TEST BLUEPRINTS

The test blueprints for each assessment include lists of all the standards, organized by reporting categories. The test blueprints also contain the Depth of Knowledge (DOK) level assigned to each standard and the range of test items to be part of the assessment by indicator. The NeSA-R test blueprint was developed and approved in fall 2009 (Appendix A). The NeSA-M test blueprint was developed and approved in fall 2010 (Appendix B). The NeSA-S test blueprint was developed and approved in fall 2011 (Appendix C).

2.3 MULTIPLE-CHOICE ITEMS

Each assessment incorporates multiple-choice (MC) items to assess the content standards. Students are required to select a correct answer from four response choices with a single correct answer. Each MC item is scored as right or wrong and has a value of one raw score point. MC items are used to assess a variety of skill levels in relation to the tested standards.

2.4 PASSAGE SELECTION

All items in the reading assessment were derived from a selection of narrative and informational passages. Passages acquired were "authentic" in that they were purchased from the test vendor that commissioned experienced passage writers to provide quality pieces of text. Passages were approved by a group of reading content specialists that have teaching experience at specific grade levels. These experts were given formal training on the specific requirements of the Nebraska assessment of reading. The group, under the facilitation of the NDE test development team, screened and edited passages for:

- interest and accuracy of information in a passage to a particular grade level;
- grade-level appropriateness of passage topic and vocabulary;
- rich passage content to support the development of high-quality test questions;
- bias, sensitivity, and fairness issues; and
- readability considerations and concerns.

Passages that were approved moved forward for the development of test items.

The readability of a passage was an evaluative process made by Nebraska educators, the NDE's test development team, DRC's reading content specialists, and other individuals who understand each particular grade level and children of a particular age group. In addition, formal readability programs were also used by DRC to provide a "snapshot" of a passage's reading difficulty based on sentence structure, length of words, etc. All of this information, along with the classroom context and content appropriateness of a passage, was taken into consideration when placing a passage at a particular grade.

2.5 ITEM DEVELOPMENT AND REVIEW

The most significant considerations in the item and test development process are: aligning the items to the grade level indicators; determining the grade-level appropriateness; DOK; estimated difficulty level; and determining style, accuracy, and correct terminology. In addition, the *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 1999) and *Universal Design* (Thompson, Johnstone, & Thurlow, 2002) guided the following steps in the item development process:

- Analyze the grade-level indicators and test blueprints.
- Analyze item specifications and style guides.
- Select qualified item writers.
- Develop item-writing workshop training materials.
- Train Nebraska educators to write items.
- Write items that match the standards, are free of bias, and address fairness and sensitivity concerns.
- Conduct and monitor internal item reviews and quality processes.
- Prepare passages and items for review by a committee of Nebraska educators (content and bias/sensitivity).
- Select and assemble items for field testing.
- Field test items, score the items, and analyze the data.
- Review items and associated statistics after field testing, including bias statistics.
- Update item bank.

Item Writer Training: The test items were written by Nebraska educators who were recommended for the process by an administrator. Three criteria were considered in selecting the item writers: educational role, geographic location, and experience with item writing.

Prior to developing items for NeSA, a cadre of item writers was trained with regard to:

- Nebraska content standards and test blueprints;
- cognitive levels, including DOK;
- principles of Universal Design;
- skill-specific and balanced test items for the grade level;
- developmentally appropriate structure and content;
- item-writing technical quality issues;
- bias, fairness, and sensitivity issues; and
- style considerations and item specifications.

Item Writing: To ensure that all test items met the requirements of the approved target content test blueprint and were adequately distributed across subcategories and levels of difficulty, item writers were asked to document the following specific information as each item was written:

- Alignment to the Nebraska Standards: There must be a high degree of match between a particular question and the standard it is intended to measure. Item writers were asked to clearly indicate which standard each item was measuring.

- Estimated Difficulty Level: Prior to field testing items, the item difficulties were not known, and writers could only make approximations as to how difficult an item might be. The estimated difficulty level was based upon the writer's own judgment as directly related to his or her classroom teaching and knowledge of the curriculum for a given content area and grade level. The purpose for indicating estimated difficulty levels as items were written was to help ensure that the pool of items would include a range of difficulty (easy, medium, and challenging).

- Appropriate Grade Level, Item Context, and Assumed Student Knowledge: Item writers were asked to consider the conceptual and cognitive level of each item. They were asked to review each item to determine whether or not the item was measuring something that was important and could be successfully taught and learned in the classroom.

- MC Item Options and Distractor Rationale: Writers were instructed to make sure that each item had only one clearly correct answer. Item writers submitted the answer key with the item. All distractors were plausible choices that represented common errors and misconceptions in student reasoning.

- Face Validity and Distribution of Items Based upon DOK: Writers were asked to classify the DOK of each item, using a model based on Norman Webb's work on DOK (Webb, 2002). Items were classified as one of four DOK categories: recall, skill/concept, strategic thinking, and extended thinking.

- Readability: Writers were instructed to pay careful attention to the readability of each item to ensure that the focus was on the concepts; not on reading comprehension of the item. Resources writers used to verify the vocabulary level were the *EDL Core Vocabularies* (Taylor , Frackenpohl, White, Nieroroda, Browning, & Brisner, 1989) and the *Children's Writer's Word Book* (Mogilner, 1992). In addition, every test item was reviewed by grade-level experts. They reviewed each item from the perspective of the students they teach, and they determined the validity of the vocabulary used.

- Grammar and Structure for Item Stems and Item Options: All items were written to meet technical quality, including correct grammar, syntax, and usage in all items, as well as parallel construction and structure of text associated with each MC item.

Item Review: Throughout the item development process, independent panels of reading content experts reviewed the items. The following guidelines for reviewing assessment items were used during each review process.

A quality item should:

- have only one clear correct answer and contain answer choices that are reasonably parallel in length and structure;
- have a correctly assigned content code (item map);
- measure one main idea or problem;
- measure the objective or curriculum content standard it is designed to measure;

- be at the appropriate level of difficulty;
- be simple, direct, and free of ambiguity;
- make use of vocabulary and sentence structure that is appropriate to the grade level of the student being tested;
- be based on content that is accurate and current;
- when appropriate, contain stimulus material that are clear and concise and provide all information that is needed;
- when appropriate, contain graphics that are clearly labeled;
- contain answer choices that are plausible and reasonable in terms of the requirements of the question, as well as the students' level of knowledge;
- contain distractors that relate to the question and can be supported by a rationale;
- reflect current teaching and learning practices in the content area; and
- be free of gender, ethnic, cultural, socioeconomic, and regional stereotyping bias.

Following each review process, the item writer group and the item review panel discussed suggestions for revisions related to each item. Items were revised only when both groups agreed on the proposed change.

Editorial Review of Items: After items were written and reviewed, the NDE test development specialists reviewed each item for item quality, making sure that the test items were in compliance with guidelines for clarity, style, accuracy, and appropriateness for Nebraska students. Additionally, DRC test development content experts worked collaboratively with the NDE to review and revise the items prior to field testing to ensure highest level of quality possible.

Review of the Online Items: All items for online assessment were reviewed by the NDE, computerized Assessments and Learning (CAL), DRC's online partner, and DRC. In addition to DRC's standard review process to which all items are subjected, and to ensure comparability with paper and pencil versions, all items were reviewed for formatting and scrolling concerns.

Universally Designed Assessments: Universally designed assessments allow participation of the widest possible range of students and result in valid inferences about performance of all students who participate and 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). The NDE and DRC are committed to the development of items and tests that are fair and valid for all students. At every stage of the item and test development process, procedures ensure that items and tests are designed and developed using the elements of universally designed assessments that were developed by the National Center on 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)(l)]. Both Title 1 and IDEA regulations call for universally designed assessments that are accessible and valid for all students including students with disabilities and students with limited English proficiency. The NDE

and DRC recognize that the benefits of universally designed assessments not only apply to these groups of students, but to all individuals with wide-ranging characteristics.

The NDE test development team and Nebraska item writers have been fully trained in the elements of Universal Design as it relates to developing large-scale statewide assessments. Additionally, the NDE and DRC partner to ensure that all items meet the Universal Design requirements during the item review process.

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).

Inclusive Assessment Population

When tests are first conceptualized, they need to be thought of in the context of who will be tested. If the test is designed for state, district, or school accountability purposes, the target population must include every student except those who will participate in accountability through an alternate assessment. The NDE and DRC are fully aware of increased demands that statewide assessment systems must include and be accountable for ALL students.

Precisely Defined Constructs

An important function of well-designed assessments is that they actually measure what they are intended to measure. The NDE item writers and DRC carefully examine what is to be tested and design items that offer the greatest opportunity for success within those constructs. Just as universally designed architecture removes physical, sensory, and cognitive barriers to all types of people in public and private structures, universally designed assessments must remove all non-construct-oriented cognitive, sensory, emotional, and physical barriers.

Accessible, Non-biased Items

The NDE conducts both internal and external review of items and test specifications to ensure that they do not create barriers because of lack of sensitivity to disability, cultural, or other subgroups. Items and test specifications are 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 that accessibility is woven into the fabric of the test rather than being added after the fact.

Amenable to Accommodations

Even though items on universally designed assessments will be accessible for most students, there will still be some students who continue to need accommodations. Thus, another essential element of any universally designed assessment is that it is compatible with accommodations and a variety of widely used adaptive equipment and assistive technology. The NDE, DRC, and CAL work to ensure that state guidelines on the use of accommodations are compatible with the assessment being developed.

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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. Directions and questions need to be in simple, clear, and understandable language. Knowledge questions that are posed within complex language certainly invalidate the test if students cannot understand how they are expected to respond to a question.

Maximum Readability and Comprehensibility

A variety of guidelines exist to ensure that text is maximally readable and comprehensible. These features go beyond what is measured by readability formulas. Readability and comprehensibility are affected by many characteristics, including student background, sentence difficulty, organization of text, and others. All of these features are considered as the NDE develops the text of assessments.

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 are used during the NDE's editing process:

- Reduce excessive length.
- Use common words.
- Avoid ambiguous words.
- Avoid irregularly spelled words.
- Avoid proper names.
- Avoid inconsistent naming and graphic conventions.
- Avoid unclear signals about how to direct attention.
- Mark all questions.
- 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 results 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. DRC works closely with the NDE to develop a style guide that includes dimensions of style that are consistent with universal design.

DOK: Interpreting and assigning DOK levels to both objectives within standards and assessment items is an essential requirement of alignment analysis. Four levels of DOK are used for this analysis. The NeSA assessments include items written at levels 1, 2, and 3. Level 4 items are not included due to the test being comprised of only MC items.

Reading Level 1

Level 1 requires students to receive or recite facts or to use simple skills or abilities. Oral reading that does not include analysis of the text as well as basic comprehension of a text is included. Items require only a shallow understanding of text presented and often consist of verbatim recall from text or simple understanding of a single word or phrase. Some examples that represent, but do not constitute all of, Level 1 performance are:

- Support ideas by reference to details in the text.
- Use a dictionary to find the meaning of words.
- Identify figurative language in a reading passage.

Reading Level 2

Level 2 includes the engagement of some mental processing beyond recalling or reproducing a response; it requires both comprehension and subsequent processing of text or portions of text. Intersentence analysis of inference is required. Some important concepts are covered, but not in a complex way. Standards and items at this level may include words such as summarize, interpret, infer, classify, organize, collect, display, compare, and determine whether fact or opinion. Literal main ideas are stressed. A Level 2 assessment item may require students to apply some of the skills and concepts that are covered in Level 1. Some examples that represent, but do not constitute all of, Level 2 performance are:

- Use context cues to identify the meaning of unfamiliar words.
- Predict a logical outcome based on information in a reading selection.
- Identify and summarize the major events in a narrative.

Reading Level 3

Deep knowledge becomes more of a focus at Level 3. Students are encouraged to go beyond the text; however, they are still required to show understanding of the ideas in the text. Students may be encouraged to explain, generalize, or connect ideas. Standards and items at Level 3 involve reasoning and planning. Students must be able to support their thinking. Items may involve abstract theme identification, inference across an entire passage, or students' application of prior knowledge. Items may also involve more superficial connections between texts. Some examples that represent, but do not constitute all of, Level 3 performance are:

- Determine the author's purpose and describe how it affects the interpretation of a reading selection.
- Summarize information from multiple sources to address a specific topic.
- Analyze and describe the characteristics of various types of literature.

Reading Level 4

Higher-order thinking is central and knowledge is deep at Level 4. The standard or assessment item at this level will probably be an extended activity, with extended time provided. The extended time

period is not a distinguishing factor if the required work is only repetitive and does not require applying significant conceptual understanding and higher-order thinking. Students take information from at least one passage and are asked to apply this information to a new task. They may also be asked to develop hypotheses and perform complex analyses of the connections among texts. Some examples that represent, but do not constitute all of, Level 4 performance are:

- Analyze and synthesize information from multiple sources.
- Examine and explain alternative perspectives across a variety of sources.
- Describe and illustrate how common themes are found across texts from different cultures.

Mathematics Level 1

Level 1 includes the recall of information such as a fact, definition, term, or a simple procedure, as well as performing a simple algorithm or applying a formula. That is, in mathematics, a one-step, well-defined, and straight algorithmic procedure should be included at this lowest level. Other key words that signify a Level 1 include "identify," "recall," "recognize," "use," and "measure." Verbs such as "describe" and "explain" could be classified at different levels, depending on what is to be described and explained.

Mathematics Level 2

Level 2 includes the engagement of some mental processing beyond a habitual response. A Level 2 assessment item requires students to make some decisions as to how to approach the problem or activity, whereas Level 1 requires students to demonstrate a rote response, perform a well-known algorithm, follow a set procedure (like a recipe), or perform a clearly defined series of steps. Keywords that generally distinguish a Level 2 item include "classify," "organize," "estimate," "make observations," "collect and display data," and "compare data." These actions imply more than one step. For example, to compare data requires first identifying characteristics of the objects or phenomenon and then grouping or ordering the objects. Some action verbs, such as "explain," "describe," or "interpret" could be classified at different levels depending on the object of the action. For example, if an item required students to explain how light affects mass by indicating there is a relationship between light and heat, this is considered a Level 2. Interpreting information from a simple graph, requiring reading information from the graph, also is a Level 2. Interpreting information from a complex graph that requires some decisions on what features of the graph need to be considered and how information from the graph can be aggregated is a Level 3. Caution is warranted in interpreting Level 2 as only skills because some reviewers will interpret skills very narrowly, as primarily numerical skills. Such interpretation excludes from this level other skills, such as visualization skills and probability skills, which may be more complex simply because they are less common. Other Level 2 activities include explaining the purpose and use of experimental procedures; carrying out experimental procedures; making observations and collecting data; classifying, organizing, and comparing data; and organizing and displaying data in tables, graphs, and charts.

Mathematics Level 3

Level 3 requires reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. In most instances, requiring students to explain their thinking is a Level 3. Activities that require students to make conjectures are also at this level. The cognitive demands at Level 3 are complex and abstract. The complexity does not result from the fact that there are multiple answers, a possibility for both Levels 1 and 2, but because the task requires more demanding reasoning. An activity, however, that has more than one possible answer and requires students to justify the response they give would most likely be a Level 3. Other Level 3 activities include drawing conclusions from observations, citing evidence and developing a logical argument for concepts, explaining phenomena in terms of concepts, and using concepts to solve problems.

Mathematics Level 4

Level 4 requires complex reasoning, planning, developing, and thinking most likely over an extended period of time. The extended time period is not a distinguishing factor if the required work is only repetitive and does not require applying significant conceptual understanding and higher-order thinking. For example, if a student has to take the water temperature from a river each day for a month and then construct a graph, this would be classified as a Level 2. However, if the student were to conduct a river study that requires taking into consideration a number of variables, this would be a Level 4. At Level 4, the cognitive demands of the task should be high and the work should be very complex. Students should be required to make several connections—relate ideas *within* the content area or *among* content areas—and have to select one approach among many alternatives on how the situation should be solved, in order to be at this highest level. Level 4 activities include designing and conducting experiments, making connections between a finding and related concepts and phenomena, combining and synthesizing ideas into new concepts, and critiquing experimental designs.

Science Level 1

Level 1 (Recall and Reproduction) requires the recall of information, such as a fact, definition, term, or a simple procedure, as well as performance of a simple science process or procedure. Level 1 only requires students to demonstrate a rote response, use a well-known formula, follow a set procedure (like a recipe), or perform a clearly defined series of steps. A "simple" procedure is well defined and typically involves only one step. Verbs such as "identify," "recall," "recognize," "use," "calculate," and "measure" generally represent cognitive work at the recall and reproduction level. Simple word problems that can be directly translated into and solved by a formula are considered Level 1. Verbs such as "describe" and "explain" could be classified at different DOK levels, depending on the complexity of what is to be described and explained. A student answering a Level 1 item either knows the answer or does not: that is, the item does not need to be "figured out" or "solved." In other words, if the knowledge necessary to answer an item automatically provides the answer to it, then the item is at Level

1. If the knowledge needed to answer the item is not automatically provided in the stem, the item is at least at Level 2. Some examples that represent, but do not constitute all of, Level 1 performance are:

- Recall or recognize a fact, term, or property.
- Represent in words or diagrams a scientific concept or relationship.
- Provide or recognize a standard scientific representation for simple phenomenon.
- Perform a routine procedure, such as measuring length.

Science Level 2

Level 2 (Skills and Concepts) includes the engagement of some mental processing beyond recalling or reproducing a response. The content knowledge or process involved is **more complex** than in Level 1. Items require students to make some decisions as to how to approach the question or problem. Keywords that generally distinguish a Level 2 item include "classify," "organize," "estimate," "make observations," "collect and display data," and "compare data." These actions imply **more than one step**. For example, to compare data requires first identifying characteristics of the objects or phenomena and then grouping or ordering the objects. Level 2 activities include making observations and collecting data; classifying, organizing, and comparing data; and organizing and displaying data in tables, graphs, and charts. Some action verbs, such as "explain," "describe," or "interpret," could be classified at different DOK levels, depending on the complexity of the action. For example, interpreting information from a simple graph, requiring reading information from the graph, is a Level 2. An item that requires interpretation from a complex graph, such as making decisions regarding features of the graph that need to be considered and how information from the graph can be aggregated, is at Level 3. Some examples that represent, but do not constitute all of, Level 2 performance are:

- Specify and explain the relationship between facts, terms, properties, or variables.
- Describe and explain examples and non-examples of science concepts.
- Select a procedure according to specified criteria and perform it.
- Formulate a routine problem, given data and conditions.
- Organize, represent, and interpret data.

Science Level 3

Level 3 (Strategic Thinking) requires reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. The cognitive demands at Level 3 are complex and abstract. The complexity does not result only from the fact that there could be multiple answers, a possibility for both Levels 1 and 2, but because the multi-step task requires more demanding reasoning. In most instances, requiring students to explain their thinking is at Level 3; requiring a very simple explanation or a word or two should be at Level 2. An activity that has more than one possible answer and requires students to justify the response they give would most likely be a Level 3. Experimental designs in Level 3 typically involve more than one dependent variable.

Other Level 3 activities include drawing conclusions from observations; citing evidence and developing a logical argument for concepts; explaining phenomena in terms of concepts; and using concepts to solve non-routine problems. Some examples that represent, but do not constitute all of, Level 3 performance are:

- Identify research questions and design investigations for a scientific problem.
- Solve non-routine problems.
- Develop a scientific model for a complex situation.
- Form conclusions from experimental data.

Science Level 4

Level 4 (Extended Thinking) involves high cognitive demands and complexity. Students are required to make several connections—relate ideas within the content area or among content areas—and have to select or devise one approach among many alternatives to solve the problem. Many on-demand assessment instruments will not include any assessment activities that could be classified as Level 4. However, standards, goals, and objectives can be stated in such a way as to expect students to perform extended thinking. "Develop generalizations of the results obtained and the strategies used and apply them to new problem situations," is an example of a grade 8 objective that is a Level 4. Many, but not all, performance assessments and open-ended assessment activities requiring significant thought will be Level 4.

Level 4 requires complex reasoning, experimental design and planning, and probably will require an extended period of time either for the science investigation required by an objective, or for carrying out the multiple steps of an assessment item. However, the extended time period is not a distinguishing factor if the required work is only repetitive and does not require applying significant conceptual understanding and higher-order thinking. For example, if a student has to take the water temperature from a river each day for a month and then construct a graph, this would be classified as a Level 2 activity. However, if the student conducts a river study that requires taking into consideration a number of variables, this would be a Level 4. Some examples that represent, but do not constitute all of, Level 4 performance are:

- Based on data provided from a complex experiment that is novel to the student, deduce the fundamental relationship between a controlled variable and an experimental variable.
- Conduct an investigation, from specifying a problem to designing and carrying out an experiment, to analyzing its data and forming conclusions.

Source of Challenge Criterion

Source of Challenge criterion is only used to identify items where the major cognitive demand is inadvertently placed and is other than the targeted skill, concept, or application. Cultural bias or specialized knowledge could be reasons for an item to have a source of challenge problem. Such items'

characteristics may cause some students to not answer an assessment item or answer an assessment item incorrectly or at a lower level even though they have the understanding and skills being assessed.

Item Content Review: Prior to field testing, all newly developed test passages/items were submitted to grade-level content committees for review. The content committees consisted of Nebraska educators from school districts throughout the state. The primary responsibility of the content committees was to evaluate items with regard to quality and content classification, including grade-level appropriateness, estimated difficulty, DOK, and source of challenge. They also suggested revisions, if appropriate. The committees also reviewed the items for adherence to the principles of universal design, including language demand and issues of bias, fairness, and sensitivity.

Item review committee members were selected by the NDE. The NDE test development team members facilitated the process. Training was provided by the NDE and included how to review items for technical quality and content quality, including DOK and adherence to principles of universal design. In addition, training included providing committee members with the procedures for item review.

Committee members reviewed the items for quality and content, as well as for the following categories:

- Indicator (standard) Alignment
- Difficulty Level (classified as Low, Medium, or High)
- DOK (classified as Recall, Application, or Strategic Thinking)
- Correct Answer
- Quality of Graphics
- Appropriate Language Demand
- Freedom from Bias (classified as Yes or No)

Committee members were asked to flag items that needed revision and to denote suggested revisions on the flagged item cards.

Security was addressed by adhering to a strict set of procedures. Items in binders did not leave the meeting rooms and were accounted for at the end of each day before attendees were dismissed. All attendees, with the exception of the NDE staff, were required to sign a Confidentiality Agreement (Appendix D).

Sensitivity and Bias Review: Prior to field testing items, all newly developed test items were submitted to a Bias and Sensitivity Committee for review. The committee's primary responsibility was to evaluate passages and items as to acceptability with regard to bias and sensitivity issues. They also made recommendations for changes or deletion of items in order to remove the area of concern. The bias/sensitivity committee was composed of Nebraska educators who represented the diversity of students. All committee members were trained by an NDE test development lead to review items for bias and sensitivity issues using *Fairness in Testing* training manual developed by DRC (Appendix E).

All passages/items were read by all of the respective committee members. Each member noted bias and/or sensitivity comments on a review form. All comments were then compiled and the actions taken on these items were recorded by the NDE. Committee members were required to sign a Confidentiality Agreement and strict security measures were in place to ensure that secure materials remained guarded (Appendix D).

2.6 ITEM BANKING

DRC maintains an item bank (IDEAS) that provides a repository of item image, history, statistics, and usage. IDEAS includes a record of all newly created items together with item data from each item field test. It also includes all data from the operational administration of the items. Within IDEAS, DRC:

- updates the Nebraska item bank after each administration;
- updates the Nebraska item bank with newly developed items;
- monitors the Nebraska item bank to ensure an appropriate balance of items aligned with content standards, goals, and objectives;
- monitors item history statistics; and
- monitors the Nebraska item bank for an appropriate balance of DOK levels.

2.7 THE OPERATIONAL FORM CONSTRUCTION PROCESS

The Spring 2013 operational forms were constructed in Lincoln, Nebraska in August 2012 (Reading and Mathematics) and September 2012 (Science). The forms were constructed by NDE representatives and DRC content specialists. Training was provided by DRC for the forms construction process.

Prior to the construction of the operational forms, DRC Test Development content specialists reviewed the test blueprints to ensure that there was alignment between the items and the indicators, including the number of items per standard for each content-area test.

DRC Psychometricians provided Test Development specialists with an overview of the psychometric guidelines and targets for operational forms construction. The foremost guideline was for item content to match the test blueprint (Table of Specifications) for the given content. The point-biserial correlation guideline was to be greater than 0.3 (with a requirement for no point-biserial correlation less than zero). In addition, the average target *p*-value for each test was to be about 0.65. A Differential Item Functioning (DIF) code of C was to be avoided (unless no other items were available to fulfill a blueprint requirement). The overall summary of the actual approved *p*-value and biserial of the forms is provided in the summary table later in this document.

DRC Test Development specialists printed a copy of each item card, with accompanying item characteristics, image, and psychometric data. Test Development specialists verified the accuracy of each item card, making sure that the item image has its correct item characteristics. Test Development specialists carefully reviewed each item card's psychometric data to ensure it is complete and

reasonable. For Reading, the item cards (items and passages) were compiled in binders and sorted by *p*-values from highest to lowest by passage with associated items. For Mathematics and science, the item cards were compiled in binders and sorted by *p*-values from highest to lowest by standard and indicator.

The NDE and DRC also checked to see that each item met technical quality for well-crafted items, including:

- only one correct answer,
- wording that is clear and concise,
- grammatical correctness,
- appropriate item complexity and cognitive demand,
    - appropriate range of difficulty,
    - appropriate depth-of-knowledge alignment,
- aligned with principles of Universal Design, and
- free of any content that might be offensive, inappropriate, or biased (content bias).

NDE representatives and DRC Test Development specialists made initial grade-level selections of the items (passages and items for Reading), known as the "pull list," to be included on the 2013 operational forms. The goal was for the first pull of the items to meet the Table of Specification (TOS) guidelines and psychometric guidelines specific to each content area. As items were selected, the unique item codes were entered into a form building template which contained the item pool with statistics and item characteristics. The template automatically calculated the *p*-value, biserial, number of items per indicator and standard, number of items per DOK level (1, 2, or 3), and distribution of answer key as items were selected for each grade. As items were selected, the item characteristics (key, DOK, and alignment to indicator) were verified.

Differential Item Functioning in Operational Form Construction: DIF is present when the likelihood of success on an item is influenced by group membership. A pattern of such results may suggest the presence of, but does not prove, *item bias*. Actual item bias may present negative group stereotypes, may use language that is more familiar to one subpopulation than to another, or may present information in a format that disadvantages certain learning styles. While the source of item bias is often clear to trained judges, many instances of DIF may have no identifiable cause (resulting in false positives). As such, DIF is not used as a substitute for rigorous, hands-on reviews by content and bias specialists. Instead, DIF helps to organize the review of the instances in which bias is suggested. No items are automatically rejected simply because a statistical method flagged them or automatically accepted because they were not flagged.

During the operational form-pull process, the DIF code for every item proposed for use in the operational (core) is examined. To the greatest extent possible, the blueprint is met through the use of items with statistical DIF codes of A. Although DIF codes of B and C are not desirable and are deliberately avoided, the combination of the required blueprint and the depth of the available

operational-ready item pool occasionally requires that items with B and C DIF are considered for operational use. In addition, for passage-based tests like reading (in which each item available in the item pool is linked to a set of passage-based items), the ability to use a minimum number of items associated with a passage may require the use of an item with a B or C DIF code. In any case, prior to allowing exceptions of this nature, every attempt is made to re-craft the core to avoid the use of the item with B or C DIF. Before allowing any exception to be made, the item in question is examined to determine whether the suggested bias is identifiable. If the suggested bias is determined to be valid, the item is not used.

Review of the Items and Test Forms: At every stage of the test development process the match of the item to the content standard was reviewed and verified, since establishing content validity is one of the most important aspects in the legal defensibility of a test. As a result, it is essential that an item selected for a form link directly to the content curriculum standard and performance standard to which it is measuring. Test Development specialists verified all items against their classification codes and item maps, both to evaluate the correctness of the classification and to ensure that the given task measures what it purports to measure.

2.8 READING ASSESSMENT

Test Design: The NeSA-R operational test includes operational passages with associated items and one field test passage with associated items. This test was administered online via the test engine developed and managed by CAL. One form of the test was also published in a printed test booklet for students needing accommodation provided by paper/pencil test. Depending on grade, the forms contained 45 to 50 operational items.

Table 2.8.1 Reading 2013 Operational Test

Grade	Total No. of MC Core Items	No. of Embedded FT Items per Form (1 passage)	Total Items per Form	Total No. of Equivalent FT Forms	Total Core Points	Total No. of MC Items Added to the Bank
3	45	10	55	5	45	50
4	45	10	55	5	45	50
5	48	10	58	5	48	50
6	48	10	58	5	48	50
7	48	10	58	5	48	50
8	50	10	60	5	50	50
11	50	10	60	5	50	50

Psychometric Targets: The goal for the operational forms was to meet a mean *p*-value of approximately 0.65 with values restricted to the range of 0.30 to 0.90 and point-biserial correlations greater than 0.25, based on previous field test results. However, these targets are secondary to constructing the best test possible. Some compromises were allowed when necessary to best meet the objective of the assessment, to conform to the test specifications, and to operate within the limitations of the item bank.

Equating Design: Spring 2013 was the fourth operational administration of NeSA-R. Approximately 70% of the assessment was constructed from passages and related items field tested from Spring 2009–2012. The approximate remaining 30% of the assessment was constructed from an overlap of items and passages from the 2010, 2011 and 2012 operational (core) item positions from the Spring 2010, 2011 and 2012 operational forms.

In addition to the operational passage sets, each student received one randomly selected field test passage with items. The passages and items taken by each student were administered in two testing sessions each intended to be administered in a single class period. The operational passages were administered to the student in a random order, but the field test passage was maintained in a fixed position. Items within a passage were administered in a fixed order for the passage. Equating was accomplished by anchoring on the operational passage items and calibrating the field test items concurrently.

2.9 MATHEMATICS ASSESSMENT

Test Design: The NeSA-M operational test includes operational and field test items. This test was administered online via the test engine developed and managed by CAL. One form of the test was also published in a printed test booklet for students needing accommodation provided by paper/pencil test. Depending on grade, the forms contained 50 to 60 operational items.

Table 2.9.1 Mathematics 2013 Operational Test

Grade	Total No. of MC Core Items	No. of Embedded FT Items per Form	Total Items per Form	Total No. of Equivalent FT Forms	Total Core Points	Total No. of MC Items Added to the Bank
3	50	10	60	5	50	50
4	55	10	65	5	55	50
5	55	10	65	5	55	50
6	58	10	68	5	58	50
7	58	10	68	5	58	50
8	60	10	70	5	60	50
11	60	10	70	5	60	50

Psychometric Targets: The goal for the operational forms was to meet a mean *p*-value of approximately 0.65 with values restricted to the range of 0.3 to 0.9 and point-biserial correlations greater than 0.25, based on previous field test results. However, these targets are secondary to constructing the best test possible. Some compromises were allowed when necessary to best meet the objective of the assessment, to conform to the test specifications, and to operate within the limitations of the item bank.

Equating Design: Spring 2013 was the third operational administration of NeSA-M. Approximately 70% of the assessment was constructed from items field tested from Spring 2010–2012. The approximate remaining 30% of the assessment was constructed from an overlap of items from the 2011 and 2012 operational (core) item positions from the 2011 and 2012 operational forms.

In addition to the operational items, each student received 10 randomly selected field test items. The items taken by each student were administered in two testing sessions each intended to be administered in a single class period. The operational items were administered to the student in a random order, but the field test items were maintained in fixed positions. Equating was accomplished by anchoring on the operational items and calibrating the field test items concurrently.

2.10 SCIENCE ASSESSMENT

Test Design: The NeSA-S operational test includes operational and field test items. This test was administered online via the test engine developed and managed by CAL. One form of the test was also published in a printed test booklet for students needing accommodation provided by paper/pencil test. Depending on grade, the forms contained 50 to 60 operational items.

Table 2.10.1 Science 2013 Operational Test

Grade	No. Operational Items	No. of Embedded FT Items per Form	Total Items	Total No. of FT Forms	Total No. of Items Field Tested
5	50	10	60	5	50
8	60	10	70	5	50
11	60	10	70	5	50

Psychometric Targets: The goal for the operational forms was to meet a mean *p*-value of approximately 0.65 with values restricted to the range of 0.3 to 0.9 and point-biserial correlations greater than 0.25, based on previous field test results. However, these targets are secondary to constructing the best test possible. Some compromises were allowed when necessary to best meet the

objective of the assessment, to conform to the test specifications, and to operate within the limitations of the item bank.

Equating Design: Spring 2013 was the second operational administration of NeSA-S. Approximately 70% of the assessment was constructed from items field tested in Spring 2011 and 2012. The approximate remaining 30% of the assessment was constructed from an overlap of items from the 2012 operational (core) item positions from the 2012 operational forms.

In addition to the operational items, each student received 10 randomly selected field test items. The items taken by each student were administered in two testing sessions each intended to be administered in a single class period. The operational items were administered to the student in a random order, but the field test items were maintained in fixed positions. Equating was accomplished by anchoring on the operational items and calibrating the field test items concurrently.

3. STUDENT DEMOGRAPHICS

Three areas of student demographics are discussed below, summary demographics and accommodations, summary information on the number of students tested with breakdowns by mode, and summary information on testing times.

3.1 DEMOGRAPGICS AND ACCOMMODATIONS

Gender, ethnicity, food program status (FRL), Limited English Proficiency/English Language Learners (LEP/ELL) status, Special Education status (SPED), and accommodation status data was collected for all students who participated and attempted the 2013 NeSA assessments. This summary of student demographics by grade and content area is provided in Tables 3.1.1– 3.1.7. These tables show that for each grade, over 22,000 students took the assessment. Of those students across grades, half are males, half are females, over half are white, and less than one fifth are Hispanic. Among the students across grades, about 35% to 47% are eligible for FRL, 2% to 8% are LEP/ELL, and 11% to 15% belong to at least one SPED category. For all three of these programs/categories, the participation rate is lower for upper grade students. In terms of the test accommodations, there are about 5% to 14% of the students across grade and content area that report at least one type of accommodation (see row 'Total' for 'Accommodation' in the table). Similar to the rate for FRL, LEP/ELL, and SPED across grades, the rate for accommodation is lower for high school students (Grade 11). Across all grades, the 'Timing/Schedule/Setting' is the most utilized accommodation (about 7-9% for Grade 3-8, and 3% for Grade 11), followed by the 'Content Presentation' (about 6-8% for Grade 3-7, and 3-5% for Grade 8 and 11). For lower-grade students, (direct or indirect) 'Linguistic Support with Content and Test Items, and Test Directions' is reported (about 4-5% for Grade 3-5), too.

Table 3.1.1 Grade 3 NeSA Summary Data: Demographics and Accommodations

Grade 3		Reading		Mathematics	
		Count	%	Count	%
All Students		22712	100.0	22752	100.0
Gender	Female	11106	48.9	11124	48.9
	Male	11606	51.1	11628	51.1
Race/Ethnicity	American Indian/Alaska Native	325	1.4	325	1.4
	Asian	490	2.2	514	2.3
	Black	1506	6.6	1510	6.6
	Hispanic	3945	17.4	3958	17.4
	Native Hawaiian or other Pacific Islander	22	0.1	22	0.1

Grade 3		Reading		Mathematics	
		Count	%	Count	%
	White	15632	68.8	15629	68.7
	Two or More Races	792	3.5	794	3.5
Food Program	Yes	10617	46.7	10640	46.8
	No	11995	52.8	12007	52.8
LEP/ELL	Yes	1904	8.4	1954	8.6
	No	20808	91.6	20798	91.4
Special Education	Yes	3330	14.7	3325	14.6
	No	19382	85.3	19427	85.4
Accommo-dations	Content Presentation	1590	7.0	1619	7.1
	Response	787	3.5	991	4.4
	Timing/Schedule/Setting	1661	7.3	1666	7.3
	Direct Linguistic Support with Test Directions	1197	5.3	1216	5.3
	Direct Linguistic Support with Content and Test items	1378	6.1	1399	6.1
	Indirect Linguistic Support	1154	5.1	1179	5.2
	Spanish	9	0.0	19	0.1
	Braille*	0	0.0	0	0.0
	Large Print*	10	0.0	9	0.0
	Total	3186	14.0	3235	14.2

*Count represents the number of booklets ordered. This is not tracked.

Table 3.1.2 Grade 4 NeSA Summary Data: Demographics and Accommodations

Grade 4		Reading		Mathematics	
		Count	%	Count	%
All Students		22206	100.0	22238	100.0
Gender	Female	10745	48.4	10758	48.4
	Male	11461	51.6	11480	51.6
Race/Ethnicity	American Indian/Alaska Native	311	1.4	311	1.4

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Grade 4		Reading		Mathematics	
		Count	%	Count	%
	Asian	507	2.3	516	2.3
	Black	1435	6.5	1438	6.5
	Hispanic	3863	17.4	3887	17.5
	Native Hawaiian or other Pacific Islander	16	0.1	16	0.1
	White	15307	68.9	15304	68.8
	Two or More Races	767	3.5	766	3.4
Food Program	Yes	10159	45.7	10163	45.7
	No	11958	53.9	11970	53.8
LEP/ELL	Yes	1553	7.0	1597	7.2
	No	20653	93.0	20641	92.8
Special Education	Yes	3414	15.4	3408	15.3
	No	18792	84.6	18830	84.7
Accommo-dations	Content Presentation	1679	7.6	1723	7.7
	Response	801	3.6	1101	5.0
	Timing/Schedule/Setting	1865	8.4	1853	8.3
	Direct Linguistic Support with Test Directions	947	4.3	981	4.4
	Direct Linguistic Support with Content and Test items	1097	4.9	1136	5.1
	Indirect Linguistic Support	964	4.3	994	4.5
	Spanish	22	0.1	38	0.2
	Braille*	4	0.0	2	0.0
	Large Print*	13	0.1	14	0.1
	Total	3108	14.0	3148	14.2

*Count represents the number of booklets ordered. This is not tracked.

Table 3.1.3 Grade 5 NeSA Summary Data: Demographics and Accommodations

Grade 5		Reading		Mathematics		Science	
		Count	%	Count	%	Count	%
All Students		21982	100.0	22022	100.0	22041	100.0
Gender	Female	10862	49.4	10870	49.4	10877	49.3
	Male	11120	50.6	11152	50.6	11164	50.7
Race/Ethnicity	American Indian/Alaska Native	302	1.4	299	1.4	300	1.4
	Asian	464	2.1	482	2.2	485	2.2
	Black	1385	6.3	1388	6.3	1388	6.3
	Hispanic	3825	17.4	3852	17.5	3857	17.5
	Native Hawaiian or other Pacific Islander	25	0.1	25	0.1	25	0.1
	White	15249	69.4	15241	69.2	15251	69.2
	Two or More Races	732	3.3	735	3.3	735	3.3
Food Program	Yes	9962	45.3	9979	45.3	9990	45.3
	No	11941	54.3	11961	54.3	11971	54.3
LEP/ELL	Yes	1275	5.8	1328	6.0	1336	6.1
	No	20707	94.2	20694	94.0	20705	93.9
Special Education	Yes	3401	15.5	3394	15.4	3406	15.5
	No	18581	84.5	18628	84.6	18635	84.5
Accommo-dations	Content Presentation	1828	8.3	1800	8.2	1761	8.0
	Response	827	3.8	1145	5.2	826	3.7
	Timing/Schedule/Setting	2028	9.2	1983	9.0	1933	8.8
	Direct Linguistic Support with Test Directions	753	3.4	769	3.5	670	3.0
	Direct Linguistic Support with Content and Test items	873	4.0	919	4.2	826	3.7
	Indirect Linguistic Support	753	3.4	752	3.4	680	3.1
	Spanish	12	0.1	31	0.1	32	0.1
	Braille*	3	0.0	3	0.0	3	0.0

Grade 5		Reading		Mathematics		Science	
		Count	%	Count	%	Count	%
	Large Print*	8	0.0	8	0.0	10	0.0
	Total	3075	14.0	3066	13.9	2899	13.2

*Count represents the number of booklets ordered. This is not tracked.

Table 3.1.4 Grade 6 NeSA Summary Data: Demographics and Accommodations

Grade 6		Reading		Mathematics	
		Count	%	Count	%
All Students		21651	100.0	21703	100.0
Gender	Female	10649	49.2	10666	49.1
	Male	11002	50.8	11037	50.9
Race/Ethnicity	American Indian/Alaska Native	335	1.5	335	1.5
	Asian	468	2.2	482	2.2
	Black	1453	6.7	1458	6.7
	Hispanic	3598	16.6	3621	16.7
	Native Hawaiian or other Pacific Islander	29	0.1	29	0.1
	White	15093	69.7	15102	69.6
	Two or More Races	675	3.1	676	3.1
Food Program	Yes	9574	44.2	9597	44.2
	No	12029	55.6	12052	55.5
LEP/ELL	Yes	781	3.6	827	3.8
	No	20870	96.4	20876	96.2
Special Education	Yes	3149	14.5	3154	14.5
	No	18502	85.5	18549	85.5
Accommo- dations	Content Presentation	1643	7.6	1602	7.4
	Response	680	3.1	1051	4.8
	Timing/Schedule/Setting	1678	7.8	1642	7.6
	Direct Linguistic Support with Test Directions	529	2.4	525	2.4

Grade 6		Reading		Mathematics	
		Count	%	Count	%
	Direct Linguistic Support with Content and Test items	621	2.9	598	2.8
	Indirect Linguistic Support	520	2.4	493	2.3
	Spanish	9	0.0	33	0.2
	Braille*	1	0.0	1	0.0
	Large Print*	16	0.1	14	0.1
	Total	2592	12.0	2525	11.6

*Count represents the number of booklets ordered. This is not tracked.

Table 3.1.5 Grade 7 NeSA Summary Data: Demographics and Accommodations

Grade 7		Reading		Mathematics	
		Count	%	Count	%
All Students		21425	100.0	21464	100.0
Gender	Female	10426	48.7	10442	48.6
	Male	10999	51.3	11022	51.4
Race/Ethnicity	American Indian/Alaska Native	300	1.4	298	1.4
	Asian	376	1.8	381	1.8
	Black	1379	6.4	1375	6.4
	Hispanic	3517	16.4	3562	16.6
	Native Hawaiian or other Pacific Islander	22	0.1	22	0.1
	White	15164	70.8	15161	70.6
	Two or More Races	667	3.1	665	3.1
Food Program	Yes	9293	43.4	9301	43.3
	No	12087	56.4	12103	56.4
LEP/ELL	Yes	568	2.7	627	2.9
	No	20857	97.3	20837	97.1
Special Education	Yes	2923	13.6	2911	13.6
	No	18502	86.4	18553	86.4

Grade 7		Reading		Mathematics	
		Count	%	Count	%
Accommo-dations	Content Presentation	1260	5.9	1267	5.9
	Response	454	2.1	942	4.4
	Timing/Schedule/Setting	1433	6.7	1394	6.5
	Direct Linguistic Support with Test Directions	272	1.3	313	1.5
	Direct Linguistic Support with Content and Test items	269	1.3	316	1.5
	Indirect Linguistic Support	277	1.3	264	1.2
	Spanish	4	0.0	39	0.2
	Braille*	2	0.0	2	0.0
	Large Print*	9	0.0	6	0.0
	Total	1981	9.2	2107	9.8

*Count represents the number of booklets ordered. This is not tracked.

Table 3.1.6 Grade 8 NeSA Summary Data: Demographics and Accommodations

Grade 8		Reading		Mathematics		Science	
		Count	%	Count	%	Count	%
All Students		20984	100.0	21016	100.0	21038	100.0
Gender	Female	10214	48.7	10230	48.7	10241	48.7
	Male	10770	51.3	10786	51.3	10797	51.3
Race/Ethnicity	American Indian/Alaska Native	322	1.5	320	1.5	322	1.5
	Asian	413	2.0	422	2.0	431	2.0
	Black	1263	6.0	1272	6.1	1274	6.1
	Hispanic	3361	16.0	3388	16.1	3392	16.1
	Native Hawaiian or other Pacific Islander	23	0.1	23	0.1	22	0.1
	White	14950	71.2	14942	71.1	14947	71.0
	Two or More Races	652	3.1	649	3.1	650	3.1
Food Program	Yes	8857	42.2	8875	42.2	8886	42.2

Grade 8		Reading		Mathematics		Science	
		Count	%	Count	%	Count	%
	No	12090	57.6	12100	57.6	12110	57.6
LEP/ELL	Yes	412	2.0	464	2.2	474	2.3
	No	20572	98.0	20552	97.8	20564	97.7
Special Education	Yes	2651	12.6	2635	12.5	2646	12.6
	No	18333	87.4	18381	87.5	18392	87.4
Accommo-dations	Content Presentation	1047	5.0	1014	4.8	1049	5.0
	Response	479	2.3	863	4.1	538	2.6
	Timing/Schedule/Setting	1303	6.2	1219	5.8	1219	5.8
	Direct Linguistic Support with Test Directions	221	1.1	260	1.2	239	1.1
	Direct Linguistic Support with Content and Test items	208	1.0	272	1.3	244	1.2
	Indirect Linguistic Support	214	1.0	223	1.1	210	1.0
	Spanish	14	0.1	41	0.2	40	0.2
	Braille*	4	0.0	2	0.0	3	0.0
	Large Print*	4	0.0	2	0.0	3	0.0
	Total	1692	8.1	1785	8.5	1704	8.1

*Count represents the number of booklets ordered. This is not tracked.

Table 3.1.7 Grade 11 NeSA Summary Data: Demographics and Accommodations

Grade 11		Reading		Mathematics		Science	
		Count	%	Count	%	Count	%
All Students		20911	100.0	20910	100.0	20900	100.0
Gender	Female	10331	49.4	10328	49.4	10327	49.4
	Male	10580	50.6	10582	50.6	10573	50.6
Race/Ethnicity	American Indian/Alaska Native	251	1.2	248	1.2	248	1.2
	Asian	467	2.2	475	2.3	475	2.3
	Black	1261	6.0	1261	6.0	1260	6.0
	Hispanic	3064	14.7	3062	14.6	3054	14.6

Grade 11		Reading		Mathematics		Science	
		Count	%	Count	%	Count	%
	Native Hawaiian or other Pacific Islander	23	0.1	22	0.1	23	0.1
	White	15240	72.9	15239	72.9	15237	72.9
	Two or More Races	605	2.9	603	2.9	603	2.9
Food Program	Yes	7453	35.6	7458	35.7	7448	35.6
	No	13406	64.1	13399	64.1	13402	64.1
LEP/ELL	Yes	426	2.0	448	2.1	448	2.1
	No	20485	98.0	20462	97.9	20452	97.9
Special Education	Yes	2232	10.7	2220	10.6	2227	10.7
	No	18679	89.3	18690	89.4	18673	89.3
Accommo-dations	Content Presentation	510	2.4	533	2.5	560	2.7
	Response	192	0.9	449	2.1	278	1.3
	Timing/Schedule/Setting	724	3.5	689	3.3	705	3.4
	Direct Linguistic Support with Test Directions	90	0.4	99	0.5	92	0.4
	Direct Linguistic Support with Content and Test items	89	0.4	110	0.5	102	0.5
	Indirect Linguistic Support	116	0.6	116	0.6	117	0.6
	Spanish	22	0.1	30	0.1	33	0.2
	Braille*	1	0.0	1	0.0	1	0.0
	Large Print*	2	0.0	3	0.0	3	0.0
	Total	946	4.5	1031	4.9	968	4.6

*Count represents the number of booklets ordered. This is not tracked.

3.2 STUDENTS TESTED AND MODE SUMMARY DATA

As noted in Chapters One and Two, the 2013 NeSA assessments were administered online to the extent practical. One form of the test was also published in a printed test booklet for students needing accommodation of a paper/pencil test. Tables 3.2.1 – 3.2.3 report the number of students in each test mode. For NeSA-R, between 2% and 6% of students took the assessment in the paper-based version with the lower percentages occurring in middle and high schools.

Table 3.2.1 NeSA-R Number of Students Tested

Grade	Total	Online	Paper	Percent Paper
3	22712	21257	1455	6%
4	22206	20829	1377	6%
5	21982	20694	1288	6%
6	21651	20523	1128	5%
7	21425	20692	733	3%
8	20984	20343	641	3%
11	20911	20472	439	2%

For NeSA-M, between 2% and 7% of students took the assessment in the paper-based version.

Table 3.2.2 NeSA-M Number of Students Tested

Grade	Total	Online	Paper	Percent Paper
3	22752	21250	1502	7%
4	22238	20849	1389	6%
5	22022	20660	1362	6%
6	21703	20535	1168	5%
7	21464	20635	829	4%
8	21016	20307	709	3%
11	20910	20469	441	2%

For NeSA-S, between 2% and 6% of students took the assessment in the paper version.

Table 3.2.3 NeSA-S Number of Students Tested

Grade	Total	Online	Paper	Percent Paper
5	22041	20781	1260	6%
8	21038	20375	663	3%
11	20900	20467	433	2%

Compared to 2012, more students across content area and grade level took the NeSA tests online instead of paper in 2013.

3.3 TESTING TIME

Online testing time for the 2013 NeSA assessments was examined for each grade and content area. Figures 3.3.1, 3.3.2, and 3.3.3 contain a breakout of testing times from the 2013 NeSA-R, NeSA-M, and NeSA-S assessments respectively. The data in Tables 3.3.1, 3.3.2, and 3.3.3 were compiled based

on students who had a *single login, a single logout,* and *responded to all the items.* Similar to 2012, students from upper grade levels, on average, spent slightly less time for all content areas. For science there was a difference in the time spent in sessions 1 and 2 across all grades, indicating a tendency toward less time in the second session. As compared to 2012, the average 2013 online testing time slightly increased, especially among the lower grade students. This is probably because there are more first-time online test takers among them. The rest of the distribution of times was comparable. The outliers on the other end, greater than 90 minutes, are also interesting because this data does not include students who *paused out*, had the test ended due to inactivity, or were reactivated. It appears that they were actively involved with the test for the full time between the login and logout, but it raises the question of how fully engaged those students may have been for that amount of time.

Figure 3.3.1 Duration of Online Reading Testing Time by Grade and Session
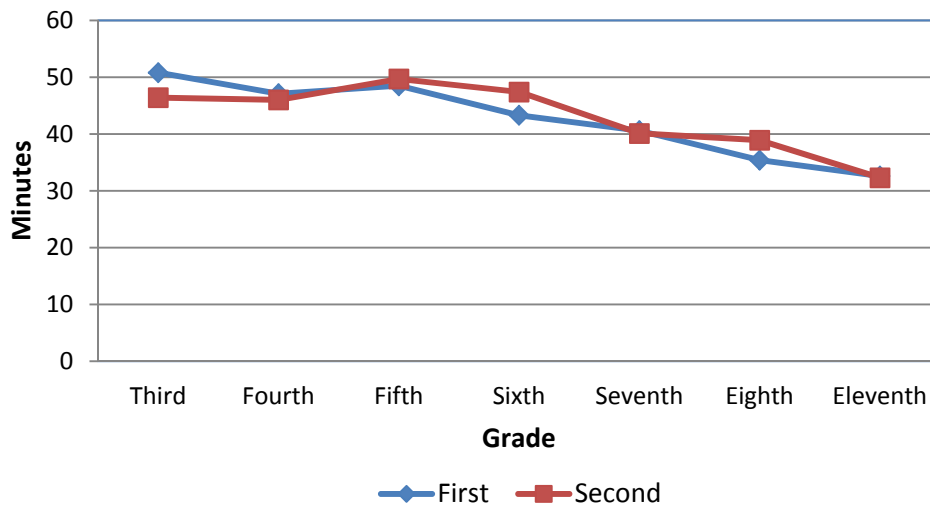
Figure 3.3.2 Duration of Online Mathematics Testing Time by Grade and Session
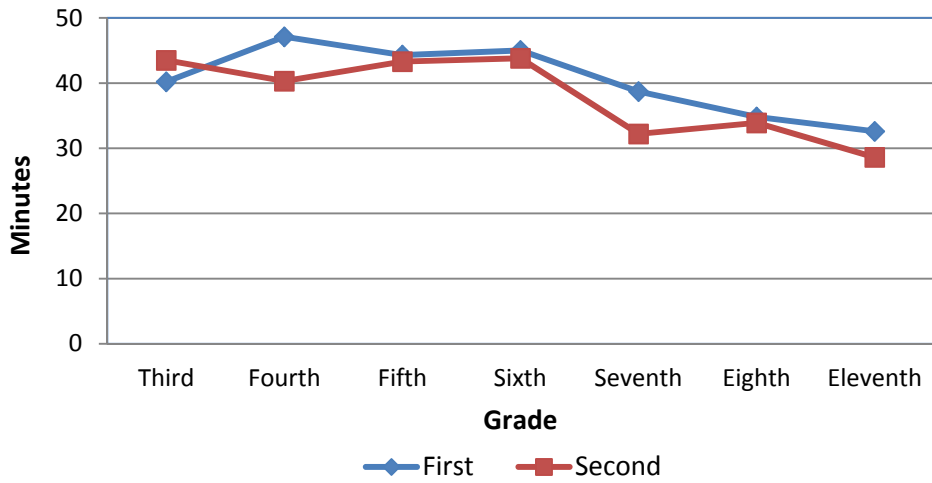
Figure 3.3.3 Duration of Online Science Testing Time by Grade and Session
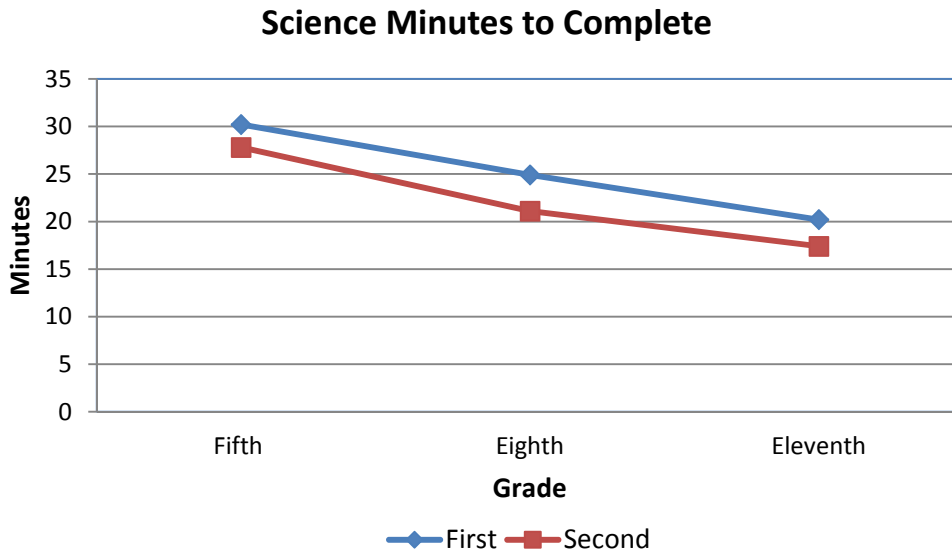
Table 3.3.1 Duration of Reading Online Testing Sessions

Grade	3		4		5		6		7		8		11	
Session	1	2	1	2	1	2	1	2	1	2	1	2	1	2
<5	0	3	0	1	1	4	1	0	0	7	4	15	42	108
5-10	3	14	1	10	2	5	3	5	10	29	28	36	113	247
10-15	22	83	26	65	28	51	39	35	72	146	162	201	364	668
15-20	154	422	255	321	199	223	337	259	360	587	778	728	1363	1794
20-25	596	1138	906	1134	718	646	1293	803	1307	1611	2617	1685	3147	2969
25-30	1288	2099	1878	2162	1692	1442	2527	1594	2761	2749	4047	2941	4257	3625
30-35	2037	2706	2672	2802	2454	2308	3312	2567	3727	3454	4109	3435	**4015**	**3602**
35-40	2610	2698	2914	2911	2972	2693	3168	3009	3414	3296	**3087**	**3289**	2856	2702
40-45	2704	2645	2585	2513	2653	2593	**2483**	2687	**2733**	**2613**	1929	2558	1734	1809
45-50	2439	**2099**	**2265**	**2021**	**2190**	**2233**	1753	**2133**	1890	1833	1202	1736	931	1014
50-55	**2051**	1712	1725	1605	1751	1811	1356	1724	1396	1308	735	1132	547	561
55-60	1655	1321	1286	1233	1306	1506	1020	1318	897	844	480	681	319	342
60-65	1331	952	1046	957	1013	1226	763	974	627	575	310	502	218	256
65-70	996	768	753	717	800	888	604	803	375	436	181	352	123	118
70-75	778	600	513	494	651	655	434	591	229	254	150	216	60	84
75-80	528	388	374	348	452	553	282	380	164	180	85	172	52	44
80-85	413	314	298	323	392	380	232	308	132	121	53	101	33	46
85-90	319	215	237	202	237	302	171	232	89	91	56	76	22	33
>90	947	771	767	749	886	915	489	699	214	248	122	199	55	70
Total	20871	20948	20501	20568	20397	20434	20267	20121	20397	20382	20135	20055	20251	20092
Mean	50.8	46.4	47.1	46.0	48.5	49.7	43.3	47.4	40.6	40.1	35.4	38.9	32.6	32.3

Table 3.3.2 Duration of Mathematics Online Testing Sessions

Grade	3		4		5		6		7		8		11	
Session	1	2	1	2	1	2	1	2	1	2	1	2	1	2
<5	1	1	1	1	0	0	2	4	5	5	7	16	94	157
5-10	10	10	2	9	3	6	2	4	17	32	31	44	179	378
10-15	195	90	29	227	34	53	27	29	73	292	135	203	428	898
15-20	1286	743	312	1259	414	482	292	347	585	1701	973	1132	1168	2337
20-25	2815	1951	1081	2639	1568	1764	1180	1252	1805	4009	2955	3121	2931	4003
25-30	3263	2966	2190	3160	2714	2771	2361	2655	3171	4498	4206	4519	4344	**4690**
30-35	2928	3059	2714	2878	3029	3063	3042	3158	3650	**3585**	**3719**	**3791**	**4055**	3366
35-40	2392	2586	2616	2432	2724	2825	2845	2870	**3310**	2310	2885	2699	2959	2029
40-45	**1872**	**2067**	2351	**1865**	**2202**	**2146**	**2477**	**2541**	2615	1480	1902	1705	1831	1088
45-50	1537	1635	**2086**	1405	1792	1727	1933	1971	1791	980	1140	983	926	531
50-55	1061	1274	1612	1136	1310	1292	1553	1382	1165	576	784	642	578	291
55-60	815	970	1342	810	1138	1070	1170	1081	745	370	510	420	332	204
60-65	598	808	951	618	827	783	834	753	510	197	314	280	195	99
65-70	540	673	744	528	644	616	600	510	304	159	175	179	104	58
70-75	384	483	573	382	506	441	445	365	200	65	137	107	59	42
75-80	269	407	478	303	423	351	357	307	150	58	75	67	37	32
80-85	240	281	334	235	302	298	276	236	70	48	65	69	31	11
85-90	193	211	248	182	188	184	193	179	64	37	33	32	20	19
>90	627	803	862	592	658	588	669	605	156	83	84	108	33	26
Total	21026	21018	20526	20661	20476	20460	20258	20249	20386	20485	20130	20117	20304	20259
Mean	40.2	43.5	47.1	40.3	44.3	43.3	45.0	43.8	38.7	32.2	34.8	33.9	32.6	28.6

Table 3.3.3 Duration of Science Online Testing Sessions

Grade	5		8		11	
Session	1	2	1	2	1	2
<5	1	2	7	18	125	195
5-10	30	101	63	257	562	1311
10-15	841	1758	1456	3937	3756	6834
15-20	3428	4427	5422	7147	7209	**6926**
20-25	4505	4466	**5605**	**4436**	**4897**	2981
25-30	3772	**3397**	3454	2190	2010	1096
30-35	**2668**	2097	1873	1060	909	397
35-40	1772	1435	1072	528	392	211
40-45	1172	978	546	275	197	106
45-50	893	676	293	131	104	78
50-55	489	449	159	108	62	43
55-60	276	279	118	62	27	36
60-65	214	154	75	38	20	15
65-70	181	118	35	26	14	13
70-75	106	75	33	25	13	9
75-80	79	63	25	17	5	7
80-85	55	50	15	11	9	9
85-90	44	44	13	8	6	3
>90	111	93	26	20	12	14
Total	20637	20662	20290	20294	20329	20284
Mean	30.2	27.8	24.9	21.1	20.2	17.4

4. CLASSICAL ITEM STATISTICS

This chapter provides an overview of the most familiar item-level statistics obtained from classical (traditional) item analysis: item difficulty, item discrimination, distractor distribution, and omits or blanks. The following results pertain only to operational NeSA items (i.e., those items that contributed to a student's total test score). Rasch item statistics are discussed in Chapter Five, and test-level statistics are found in Chapter Six. The statistics provide information about the quality of the items based on student responses in an operational setting. The following sections provide descriptions of the item summary statistics found in Appendices F, G, and H.

4.1 ITEM DIFFICULTY

Item difficulty (*p*-value) is the proportion of examinees in the sample who answered the item correctly. For example, if an item has a *p*-value of 0.89, it means 89 percent of the students answered the item correctly. Relatively lower values correspond to more difficult items and those that have relatively higher values correspond to easier items. Items that are either very hard or very easy provide little information about student differences in achievement. On a standards-referenced test like the NeSA, a test development goal is to include a wide range of item difficulties. Typically, test developers target *p*-values in the range of 0.30 to 0.90. Mathematically, information is maximized and standard errors minimized when the *p*-value equals 0.50. Experience suggests that multiple choice items are effective when the student is more likely to succeed than fail and it is important to include a range of difficulties matching the distribution of student abilities (Wright & Stone, 1979). Occasionally, items that fall outside the desired range can be justified for inclusion when the educational importance of the item content or the desire to measure students with very high or low achievement override the statistical considerations. Summary *p*-value information across all grades for each content area is shown in Tables 4.1.1 – 4.1.3. In general, most of the items fall into the *p*-value range of 0.3 to 0.9, which is appropriate for a criterion-referenced assessment.

Table 4.1.1 Summary of Traditional Item Proportion Correct for NeSA-R Operational Items

Grade	Item Proportion Correct										Mean	Total
	<=0.1	<=0.2	<=0.3	<=0.4	<=0.5	<=0.6	<=0.7	<=0.8	<=0.9	>0.9		
3	0	0	0	0	4	9	12	9	11	0	.680	45
4	0	0	0	0	4	10	10	9	10	2	.690	45
5	0	0	0	0	3	7	16	13	8	1	.691	48
6	0	0	0	2	6	7	8	9	14	2	.688	48
7	0	0	0	1	3	7	12	17	7	1	.691	48
8	0	0	0	1	0	6	16	17	10	0	.711	50
11	0	0	0	2	3	7	7	24	7	0	.682	50

Table 4.1.2 Summary of Traditional Item Proportion Correct for NeSA-M Operational Items

Grade	Item Proportion Correct										Mean	Total
	<=0.1	<=0.2	<=0.3	<=0.4	<=0.5	<=0.6	<=0.7	<=0.8	<=0.9	>0.9		
3	0	0	0	0	2	10	13	19	6	0	.687	50
4	0	0	0	0	4	17	5	16	13	0	.681	55
5	0	0	1	0	5	7	22	11	8	1	.666	55
6	0	0	0	0	2	11	20	17	8	0	.686	58
7	0	0	0	0	5	15	16	10	12	0	.670	58
8	0	0	0	0	7	8	18	19	7	1	.671	60
11	0	0	0	2	7	12	26	9	4	0	.630	60

Table 4.1.3 Summary of Traditional Item Proportion Correct for NeSA-S Operational Items

Grade	Item Proportion Correct										Mean	Total
	<=0.1	<=0.2	<=0.3	<=0.4	<=0.5	<=0.6	<=0.7	<=0.8	<=0.9	>0.9		
5	0	0	0	0	3	11	14	16	6	0	.680	50
8	0	0	0	0	8	9	15	19	9	0	.668	60
11	0	0	0	1	8	11	16	14	9	1	.660	60

4.2 ITEM-TOTAL CORRELATION

Item-total correlation describes the relationship between performance on the specific item and performance on the entire form. For the NeSA tests, Pearson's product-moment correlation coefficient between item scores and test scores is used to indicate this relationship. For MC items, the statistic is typically referred to as *point-biserial correlation*. This index indicates an item's ability to differentiate between high and low achievers (i.e., item discrimination power). It is expected that students with high ability (i.e., those who perform well on the NeSA overall) would be more likely to answer any given NeSA item correctly, while students with low ability (i.e., those who perform poorly on the NeSA overall) would be more likely to answer the same item incorrectly. However, an interaction can exist between item discrimination and item difficulty. Items answered correctly (or incorrectly) by a large proportion of examinees (i.e., the items have extreme *p*-values) can have reduced power to discriminate and thus can have lower correlations.

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. Items with negative correlations are flagged and referred to Test Development as possible mis-keys.

Mis-keyed items will be corrected and rescored prior to computing the final item statistics. Negative correlations can also indicate problems with the item content, structure, or students' opportunity to learn. Items with point-biserial values of less than 0.2 are flagged and referred to content specialists for review before being considered for use on future forms. As seen below in Tables 4.2.1 – 4.2.3, no items in the 2013 NeSA tests have negative point-biserial correlations and most are above 0.20, indicating good item discrimination.

Table 4.2.1 Summary of Point-biserial Correlations for NeSA-R

Grade	Item Point-biserial Correlation							Total
	<=0.1	<=0.2	<=0.3	<=0.4	<=0.5	<=0.6	>0.6	
3	0	0	0	12	29	4	0	45
4	0	0	1	21	20	3	0	45
5	0	0	0	17	24	7	0	48
6	0	0	0	18	24	6	0	48
7	0	0	1	13	29	5	0	48
8	0	0	2	15	25	8	0	50
11	0	0	2	15	19	14	0	50

Table 4.2.2 Summary of Point-biserial Correlations for NeSA-M

Grade	Item Point-biserial Correlation							Total
	<=0.1	<=0.2	<=0.3	<=0.4	<=0.5	<=0.6	>0.6	
3	0	0	0	14	24	11	1	50
4	0	0	0	15	27	12	1	55
5	0	0	3	16	23	12	1	55
6	0	0	0	12	21	23	2	58
7	0	0	0	12	26	18	2	58
8	0	0	1	10	36	13	0	60
11	0	0	0	5	31	21	3	60

Table 4.2.3 Summary of Point-biserial Correlations for NeSA-S

Grade	Item Point-biserial Correlation							Total
	<=0.1	<=0.2	<=0.3	<=0.4	<=0.5	<=0.6	>0.6	
5	0	0	2	17	28	3	0	50
8	0	1	5	28	23	3	0	60
11	0	0	4	16	33	7	0	60

4.3 PERCENT SELECTING EACH RESPONSE OPTION

This index indicates the effectiveness of each distractor. In general, one expects the correct response to be the most attractive, although this need not hold for unusually challenging items. This statistic for the correct response option is identical to the p-value when considering MC items with a single correct response. Please see the detailed summary statistics for each grade and content area in Appendices F, G, and H.

4.4 POINT-BISERIAL CORRELATIONS OF RESPONSE OPTIONS

This index describes the relationship between selecting a response option for a specific item and performance on the entire test. The correlation between an incorrect answer and total test performance should be negative. The desired pattern is strong positive values for the correct option and strong negative values for the incorrect options. Any other pattern indicates a problem with the item or with the key. These patterns would imply a high ability way to answer incorrectly or a low ability way to answer correctly. Examples of these situations could be an item with an ambiguous or misleading distractor that was attractive to high-performing examinees or an item that depended on experience outside of instruction that was unrelated to ability. This statistic for the correct option is identical to the item-total correlation for MC items. Please see the detailed summary statistics for each grade and content area in Appendices F, G, and H.

4.5 PERCENT OF STUDENTS OMITTING AN ITEM

This statistic is useful for identifying problems with testing time and test layout. If the omit percentage is large for a single item, it could indicate a problem with the layout or content of an item. For example, students tend to skip items with wordy stems or that otherwise appear difficult or time consuming. While there is no hard and fast rule for what *large* means, and it varies with groups and ages of students, five percent omits is often used as a preliminary screening value.

Detailed results of the item analyses for the NeSA-R operational items are presented in Appendix F. Detailed results of the item analyses for the NeSA-M operational items are presented in Appendix G. Detailed results of the item analyses for the NeSA-S operational items are presented in Appendix H. Based on these analyses, items were selected for review if the p-value was less than 0.25 and the *item-total correlation* was less than 0.2. Items were identified as probable mis-keys if the p-value for the correct response was less than one of the incorrect responses and the *item-total correlation* was negative.

5. RASCH ITEM CALIBRATION

The particular item response theory (IRT) model used for the NeSA 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 NeSA items in recent history. 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 rests strongly on the degree to which the underlying assumptions are met.

Generally, item calibration is the process of assigning a difficulty-parameter estimate to each item on an assessment so that all items are placed onto a common scale. This chapter briefly introduces the Rasch model, reports the results from evaluations of the adequacy of the Rasch assumptions, and summarizes Rasch item statistics for the 2013 NeSA Reading, Mathematics, and Science assessments.

5.1 DESCRIPTION OF THE RASCH MODEL

The Rasch rating scale model was used to calibrate the NeSA items. All NeSA assessments contain only MC items. According to the Rasch model, the probability of answering an item correctly is based on the difference between the ability of the student and the difficulty of the item. 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, the Rasch model provides estimates of a person's ability that are independent of the items employed in the assessment and conversely, estimates item difficulty independently of the sample of examinees (Rasch, 1960; Wright & Panchapakesan, 1969). (As noted in Chapter Four, interpretation of item *p*-values confounds item difficulty and student ability.) Appendix I provides a more detailed overview of Rasch Measurement.

5.2 CHECKING RASCH ASSUMPTIONS

Since the Rasch model was the basis of all calibration, scoring, and scaling analyses associated with the NeSA, the validity of the inferences from these results depends on the degree to which the assumptions of the model were 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 item fit. It should be noted that only operational items were analyzed since they are the basis of student scores.

Unidimensionality: Rasch models assume that one dominant dimension determines the difference among students' performances. Principal Components Analysis (PCA) can be used to assess the unidimensionality assumption. The purpose of the analysis is to verify whether any other dominant

component(s) exist among the items. If any other dimensions are found, the unidimensionality assumption would be violated.

Tables 5.2.1, 5.2.2, and 5.2.3 present the PCA results for the reading, mathematics, and science assessments, respectively. The results include the eigenvalues and the percentage of variance explained for the first five components. As can been seen in Table 5.2.1, the primary dimension for NeSA-R explained about 22 percent to 26 percent of the total variance across Grades 3–8 and 11. The eigenvalues of the second dimension ranged from 1.5 to 1.9. This indicates that the second dimension accounted for only 1.5 to 1.9 units out of 66 - 84 units of total variance. Similar patterns are observed for the Mathematics and the Science test. Overall, the PCA suggests that there is one clearly dominant dimension for each NeSA assessment.

Table 5.2.1 Results from PCA – Reading

Grade	Component	Eigenvalue	Explained Variance
	1	13.9	23.6%
	2	1.7	2.9%
	3	1.5	2.6%
	4	1.3	2.3%
3	5	1.2	2.1%
	1	13.2	22.6%
	2	1.6	2.7%
	3	1.3	2.3%
	4	1.2	2.1%
4	5	1.2	2.0%
	1	13.9	22.4%
	2	1.6	2.5%
	3	1.4	2.2%
	4	1.3	2.1%
5	5	1.2	2.0%
	1	17.3	26.4%
	2	1.7	2.6%
	3	1.4	2.1%
	4	1.3	2.0%
6	5	1.2	1.8%
	1	14.9	23.7%
	2	1.7	2.7%
	3	1.5	2.4%
	4	1.3	2.0%
7	5	1.2	1.9%
	1	13.9	21.8%
	2	1.5	2.3%
8	3	1.4	2.2%

Grade	Component	Eigenvalue	Explained Variance
	4	1.4	2.1%
	5	1.2	1.9%
	1	16.0	24.3%
	2	1.9	2.9%
	3	1.4	2.2%
	4	1.3	1.9%
11	5	1.2	1.8%

Table 5.2.2 Results from PCA – Mathematics

Grade	Component	Eigenvalue	Explained Variance
	1	15.6	23.8%
	2	1.7	2.5%
	3	1.5	2.2%
	4	1.4	2.2%
3	5	1.3	2.0%
	1	19.7	26.4%
	2	1.8	2.4%
	3	1.5	2.0%
	4	1.4	1.9%
4	5	1.4	1.9%
	1	18.9	25.6%
	2	1.9	2.6%
	3	1.6	2.1%
	4	1.5	2.0%
5	5	1.4	1.9%
	1	20.1	25.7%
	2	1.9	2.5%
	3	1.7	2.2%
	4	1.5	2.0%
6	5	1.4	1.8%
	1	22.1	27.6%
	2	1.9	2.4%
	3	1.6	2.0%
	4	1.5	1.9%
7	5	1.3	1.6%
	1	20.6	25.6%
	2	1.9	2.4%
	3	1.6	2.0%
	4	1.5	1.8%
8	5	1.4	1.8%
	1	23.6	28.2%
11	2	1.9	2.3%

Grade	Component	Eigenvalue	Explained Variance
	3	1.7	2.0%
	4	1.4	1.7%
	5	1.4	1.7%

Table 5.2.3 Results from PCA – Science

Grade	Component	Eigenvalue	Explained Variance
	1	14.9	22.9%
	2	1.5	2.4%
	3	1.5	2.3%
	4	1.3	2.0%
5	5	1.3	2.0%
	1	16.0	21.0%
	2	1.5	2.0%
	3	1.5	1.9%
	4	1.3	1.7%
8	5	1.2	1.6%
	1	19.7	24.7%
	2	1.8	2.3%
	3	1.4	1.8%
	4	1.3	1.7%
11	5	1.2	1.5%

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. Many indicators of LI are framed by the form of local independence proposed by McDonald (1979) that the conditional covariances of all pairs of item responses, conditioned on the abilities, are required to be equal to zero.

Residual item correlations provided in WINSTEPS for each item pair were used to assess local dependence among the NeSA items. Three types of residual correlations are available in WINSTEPS: raw, standardized, and logit. It should be noted that the raw score residual correlation essentially corresponds to Yen's $Q3$ index, a popular LI statistic. The expected value for the $Q3$ statistic is approximately $-1/(k-1)$ when no local dependence exists, where k is test length (Yen, 1993). Thus, the expected $Q3$ values should be approximately -0.02 for the NeSA tests (since most of the NeSA tests had more than 50 core items). Index values that are greater than 0.20 indicate a degree of local dependence that probably should be examined by test developers (Chen & Thissen, 1997). Since the three residual correlations are very similar, the default "standardized residual correlation" in WINSTEPS was used for these analyses. Tables 5.2.4 – 5.2.6 show the summary statistics—mean, SD,

minimum, maximum, and several percentiles (P10, P25, P50, P75, P90)—for all the residual correlations for each test. The total number of item pairs (N) and the number of pairs with the residual correlations greater than 0.20 are also reported in this table. The mean residual correlations were slightly negative and the values were close to −0.02. The vast majority of the correlations were very small, suggesting local item independence generally holds for the NeSA reading, mathematics, and science assessments.

Table 5.2.4 Summary of Item Residual Correlations for NeSA-R

Statistics	Reading						
	3	4	5	6	7	8	11
N	990	990	1128	1128	1128	1225	1225
Mean	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
SD	0.03	0.02	0.02	0.02	0.02	0.02	0.02
Minimum	-0.07	-0.08	-0.07	-0.08	-0.08	-0.08	-0.10
P10	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.05
P25	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
P50	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
P75	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
P90	0.00	0.00	0.00	0.01	0.00	0.00	0.01
Maximum	0.52	0.12	0.13	0.12	0.23	0.10	0.14
>0.20	1	0	0	0	1	0	0

Table 5.2.5 Summary of Item Residual Correlations for NeSA-M

Statistics	Mathematics						
	3	4	5	6	7	8	11
N	1225	1485	1485	1653	1653	1770	1770
Mean	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
SD	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Minimum	-0.09	-0.07	-0.10	-0.11	-0.09	-0.09	-0.10
P10	-0.04	-0.04	-0.05	-0.05	-0.04	-0.04	-0.04
P25	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
P50	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
P75	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.00
P90	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Maximum	0.26	0.36	0.32	0.48	0.39	0.42	0.34
>0.20	3	2	2	3	2	5	2

Table 5.2.6 Summary of Item Residual Correlations for NeSA-S

Statistics	Science		
	5	8	11
N	1225	1770	1770
Mean	-0.02	-0.02	-0.02
SD	0.02	0.02	0.02
Minimum	-0.06	-0.06	-0.09
P10	-0.04	-0.04	-0.04
P25	-0.03	-0.03	-0.03
P50	-0.02	-0.02	-0.02
P75	-0.01	-0.01	-0.01
P90	0.00	0.00	0.01
Maximum	0.37	0.16	0.08
>0.20	3	0	0

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. Though both are informative, the Zstd values are very likely too sensitive to the large sample sizes observed on the NeSA. In this situation it is recommended that the Zstd values be ignored if the MnSq values are acceptable (Linacre, 2009).

The outfit statistic 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, and low information responses). The infit statistic 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 researchers contend that extreme infit values are a greater threat to the measurement process than extreme outfit since most tests intend to measure the on-target population rather than extreme outliers.

The expected MnSq value is 1.0 and 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 and/or too much redundancy), and values greater than the expected value indicate underfitting items (too unpredictable and/or 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 results below, values outside of 0.7 to 1.3 are given practical importance.

Table 5.2.7 presents the summary statistics of infit and outfit mean square statistics for the NeSA reading, mathematics, and science tests, including the mean, SD, and minimum and maximum values. The number of items within the range of [0.7, 1.3] is also reported in Table 5.2.7. As can be seen, the mean values for both fit statistics were close to 1.00 for all tests. All the items had infit values falling in the range of [0.7, 1.3]. Though more outfit values fell outside this range than infit values, most of the extreme values were just barely above 1.3 or below 0.7. Overall, these results indicate that the Rasch model fits the NeSA item data well.

Table 5.2.7 Summary of Infit and Outfit Mean Square Statistics for 2013 NeSA Tests

		Infit Mean Square						Outfit Mean Square				
		Mean	SD	MIN	MAX	[0.7, 1.3]		Mean	SD	MIN	MAX	[0.7, 1.3]
Reading	3	1.00	0.11	0.70	1.28	45/45		0.99	0.18	0.57	1.37	40/45
	4	0.99	0.11	0.74	1.19	45/45		0.97	0.18	0.53	1.26	42/45
	5	0.98	0.14	0.65	1.28	46/48		0.96	0.21	0.48	1.51	41/48
	6	1.00	0.17	0.69	1.61	43/48		0.99	0.29	0.48	1.94	38/48
	7	1.00	0.11	0.61	1.29	47/48		0.98	0.19	0.39	1.43	43/48
	8	1.00	0.14	0.79	1.49	48/50		0.99	0.21	0.66	1.54	42/50
	11	1.01	0.17	0.66	1.60	46/50		0.99	0.27	0.49	2.08	43/50
Mathematics	3	1.00	0.12	0.78	1.23	50/50		1.01	0.20	0.67	1.55	45/50
	4	1.01	0.10	0.81	1.22	55/55		1.00	0.18	0.59	1.50	51/55
	5	1.00	0.13	0.71	1.40	54/55		1.00	0.21	0.57	1.76	49/55
	6	1.01	0.13	0.79	1.31	57/58		1.02	0.22	0.66	1.47	46/58
	7	0.99	0.13	0.76	1.29	58/58		0.99	0.22	0.53	1.46	49/58
	8	1.00	0.11	0.67	1.26	59/60		0.99	0.20	0.45	1.44	55/60
	11	0.99	0.11	0.74	1.32	59/60		0.99	0.18	0.57	1.61	54/60
Science	5	1.00	0.09	0.83	1.24	50/50		0.99	0.16	0.70	1.45	48/50
	8	0.99	0.10	0.74	1.24	60/60		0.98	0.16	0.63	1.52	56/60
	11	0.98	0.11	0.73	1.25	60/60		0.96	0.18	0.39	1.36	53/60

5.3 RASCH ITEM STATISTICS

Item calibration was implemented via WINSTEPS 3.75.1 program (Linacre, 2013). The characteristics of calibration samples are reported in Chapter Three. These samples only include the students who attempted the tests. All omits (no response) and multiple responses (more than one response selected) were scored as incorrect answers (coded as 0s) for calibration.

As noted earlier, the Rasch model expresses item difficulty (and student ability) in units referred

to as *logits* rather than on the proportion-correct metric. Large negative logits represent easier items while large positive logits represent more difficult items. Logits have an interval scale, meaning that two items with logits of 0.0 and +1.0 (respectively) are the same distance apart (in difficulty) as two items with logits of +3.0 and +4.0.

Appendices J, K, L, and M report the Rasch calibration summaries and logit difficulties for all the operational items. Table 5.3.1 summarizes the Rasch logit difficulties of the operational items on each test. The minimum and maximum values and standard deviations suggest that the NeSA items covered a relatively wide range of difficulties. It is important to note that the logit difficulty values presented have not been linked to a common scale of measurement. Therefore, the relative magnitude of the statistics across subject areas and grades cannot be compared. The item pool was then updated with the item statistics.

Table 5.3.1 Summary of Rasch Item Difficulties for NeSA Reading, Mathematics, and Science

	Grade	N	Mean	SD	Min	Max
Reading	3	45	-0.62	0.71	-2.08	0.87
	4	45	-0.75	0.80	-2.81	0.55
	5	48	-0.59	0.60	-1.82	0.65
	6	48	-0.71	0.91	-2.24	1.03
	7	48	-0.59	0.71	-2.04	1.03
	8	50	-0.81	0.67	-2.72	0.97
	11	50	-0.89	0.71	-2.39	0.75
Mathematics	3	50	-0.80	0.59	-1.90	0.55
	4	55	-0.82	0.78	-2.12	0.65
	5	55	-0.69	0.75	-2.51	1.02
	6	58	-0.87	0.67	-2.34	0.59
	7	58	-0.75	0.81	-2.36	0.76
	8	60	-0.81	0.73	-2.33	0.44
	11	60	-0.63	0.63	-2.09	1.07
Science	5	50	-0.91	0.69	-2.57	0.59
	8	60	-0.81	0.64	-2.03	0.53
	11	60	-0.77	0.85	-4.10	0.68

6. EQUATING AND SCALING

As a common practice in large-scale testing program, the NeSA tests were constructed to have different item sets appear in test forms across years. As noted in Chapter Two, for example, the 2013 NeSA-M test was developed such that approximately 70% of the assessment was constructed from items field tested from Spring 2010–2012, and the approximate remaining 30% of the assessment was constructed from an overlap of items from the 2011 and 2012 operational forms. To ensure that all forms for a given grade and content area provide comparable scores and the passing standards across different administrations are equivalent, the new operational items need to be placed on the bank scale via equating to bring the 2013 NeSA raw-score-to-Rasch-ability scale to the previous operational scale.

Consequently, students are not given an unfair advantage or disadvantage because the particular test form they took is easier or harder than a test form taken by other students. When the new 2013 NeSA tests are placed on the bank's scale, the resulting scale scores for the new test form will be the same as the scale scores of the previous operational form such that students performing at the same level of (underlying) achievement should receive the same score (i.e., scale score). For the NeSA, the resulting scale scores will be used for score reporting and performance level classification.

This chapter begins with a summary of the entire NeSA equating procedure. This is followed by a scaling analysis that transforms raw scores to scale scores that represent the same skill level on every test form. Some summary results of the state scale score performance are also provided.

6.1 EQUATING

The equating design employed for NeSA is often referred to as a common-item nonequivalent groups (CINEG) design, which uses a set of common anchor items to adjust for differences in test difficulty across years. As discussed earlier, the 2013 NeSA test forms were constructed with items in common with the previous administrations of test items that were either field tested or operationally tested. If the item properties (i.e., difficulty) calibrated from the previous administrations hold true for the current student population, the whole set of the 2013 NeSA operational items can serve as the linking set such that conversions from raw to scale scores can be established prior to the time when the new test is administered operationally. This is often referred to as the pre-equating process because it is conducted before the operational test is administered. The most appealing feature of the pre-equating process, when applicable, is its ability to facilitate immediate score reporting for tests which have tight reporting windows.

It may not be wise to assume that the operational items maintain their relative difficulty across years because the same item can have different properties in different years because of changes in the item's position or changes in the students' experiences. Therefore, once the 2013 operational test data is available, DRC Psychometric Services staffers evaluated the item difficulty equivalence by comparing

the old banked item calibration (called pre-calibration) with a new unanchored calibration of the 2013 data (called post-calibration). The evaluations were conducted for each grade and content area, using both visual graphing and statistical methods. The post-calibrated item difficulties (logits) were plotted against the pre-calibration for each grade and content area (see Appendices N – P). Ideally, these scatter plots should have a strong linear trend. Items straying from the trend line did not perform in the same way in both years. Below is an example of pre- and post-calibration plots for the 2013 NeSA-S test (Grade 11). Graphically, there are two apparent outlier items that stray far from the trend line. One is located at the lower left corner that, for some reason, became much easier for the population of this year. The other is near the upper right corner that, in contrast, became more difficult this year. All the other items fall more or less on the linear trend line, indicating consistent performance in both years.

Figure 6.1.1: NeSA-S Grade 11 Pre- and Post-Calibrations
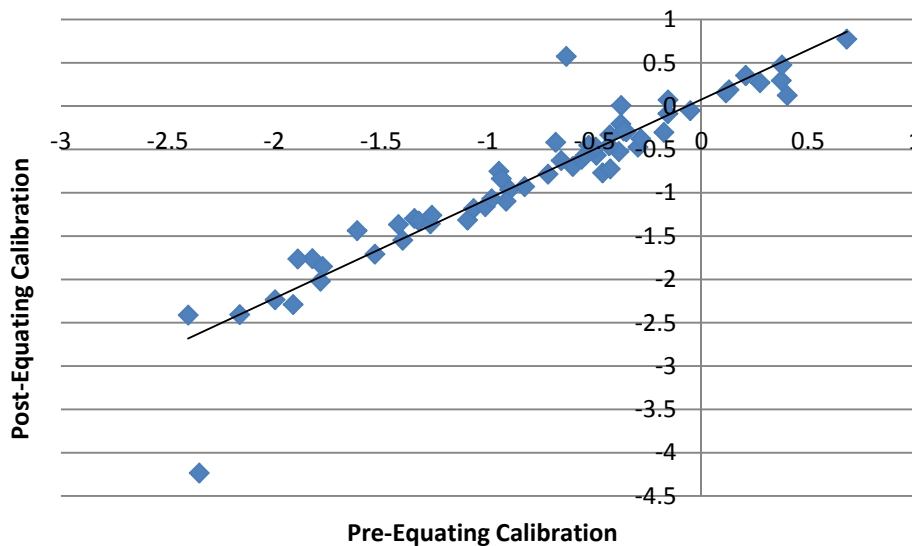
DRC Psychometric Services staff examined the robust Z statistic (Huynh, 2000; Huynh & Rawls, 2009), the correlations between the pre- and post-calibrated item difficulties, and the ratio of standard deviations (SD) between the two calibrations. For consistent item performance, critical values for comparing the robust Z statistic is 2.7, the correlations should be at least 0.95, and a ratio of standard deviations between 0.90 and 1.10 (Huynh & Meyer, 2010). The two outliers in Figure 6.1.1 are detected by a robust Z statistic greater than a critical value of 2.7 (12.33 for the lower left item and -7.75 for the upper right item). Table 6.1.1 reports these statistics of correlations and SD ratio for the 2013 NeSA-S test. Not surprisingly, the two statistics (0.94 for the correlation and 0.82 for SD ratio) for Grade 11 fall below the desired ranges, probably due to the existence of the two outlier items seen above on the plot. Appendices N – P presented these statistics for each grade and content area.

Table 6.1.1 NeSA-S Pre- and Post Equating Comparison

	Grade		
	5	8	11
Correlation	0.97	0.96	0.94
SD pre	0.69	0.64	0.74
SD post	0.71	0.70	0.91
SD Ratio	0.98	0.91	0.82

For all content areas, items that departed significantly from the linear trend or below the ideal ranges of robust *Z*, correlation, or SD ratio values were further evaluated by the NDE in determining whether to include those items in the linking set used for the equating. After evaluating the evidence for the stability between the old (banked) and new (2013) item data, the NDE decided to drop the two items from the linking set used for the 2013 NeSA-S Grade 11 test equating. In addition, the NDE decided to drop one outlier item from the linking set used for the 2013 NeSA-M Grade 6 test equating. For the other grade and content areas, the NDE decided not to drop any but keep the whole set of items in the linking set for equating. As an additional protective measure, any item that is dropped from either the test form or the equating is excluded from use on future forms.

For the 2013 NeSA-S Grade 11 and NeSA-M Grade 6 tests, test difficulty was adjusted by excluding the items mentioned above and then applied to the raw-to-scale-score conversion. This equating process is known as the post-equating because the equating happens after the administration of the operational test and the new raw-to-scale-score conversion is generated based on the operational test data. In contrast, the pre-equating process establishes the raw-to-scale-score conversion based on the previously calibrated item difficulties (and can happen prior to the administration of the operational test). For the 2013 NeSA-tests, the NDE decided to adopt the post-equating solutions for Science Grade 11 and Mathematics Grade 6 tests, and the pre-equating solutions for the other grade and content areas.

6.2 SCALING

The purpose of a scaling analysis is to create a score scale. The basic score on any test is the raw score, which is the number of items answered correctly or the total score points earned. However, the raw score alone does not present a wide-ranging picture of test performance because it is not on an equal-interval scale and can be interpreted only in terms of a particular set of items. Since a given raw score may not represent the same skill level on every test form, scale scores were assigned to each raw score point to adjust for slight shifts in item difficulties and permit valid comparison across all test administrations within a particular content area.

Defining the scale score metric is an important, albeit arbitrary, step. Mathematically, scale scores are a linear transformation of the logit scores and thus do not alter the relationships or the displays. Scale scores are the numbers that will be reported to describe the performance of the students, schools, and systems. They will define the ranges of the performance levels, appear on individual student reports and school accountability analyses, and be dissected in newspaper accounts.

Appendix Q contains the detailed raw-score-to-scale-score conversion tables that were used to assign scale scores to students based on the total number correct scores from the NeSA-R for 2013, Appendix R for NeSA-M for 2013 and Appendix S for NeSA-S 2013. Because the relationship between raw and scale scores depends on the difficulties of the specific items on the form, these tables will change for every operational form.

There are two primary considerations when establishing the metric:

- Multiply the logit by a value large enough to make decimal points unnecessary for student scores, and
- Shift the scale enough to avoid negative values for low scale scores.

The scale chosen, for all grades and content areas of the NeSA assessment, range from 0 to 200. The value of 0 is reserved for students who were not tested or were otherwise invalidated. Thus, any student who attempted the test will receive a scale score equal to 1 even if the student gave no correct responses. No student tested will receive a scale score higher than 200 or lower than 1, even if this requires constraining the scale score calculation. It is possible that a future form will be easy enough that the upper limit of 200 is not invoked even for a perfect paper or could be difficult enough that the lower limit is not invoked.

As part of its deliberations concerning defining the performance levels, the State Board of Education specified that the *Meets the Standards* performance level have a scale score of 85 and that the *Exceeds the Standards* level have a scale score of 135. The logit standards defining the performance levels were adopted by the SBE per the standard setting and standard validation completed in 2010 for NeSA-R, in 2011 for NeSA-M, and in 2012 for NeSA-S.

Complete documentation of all standard setting events are presented in separate documents and are placed on the Nebraska State Department of Education website labeled:

2010 NeSA-Reading Standard Setting Technical Report,
http://www.education.ne.gov/Assessment/pdfs/2010_NeSA_Reading_Standard_Setting_Tech_%20Report.pdf ,

 2011 NeSA-Mathematics Standard Setting Technical Report,
http://www.education.ne.gov/Assessment/pdfs/2011_NeSA_Math_Standard_Setting_Tech_Report.pdf

and *2012 NeSA-Science Standard Setting Technical Report*,
http://www.education.ne.gov/Assessment/pdfs/Final_NeSA_Science_Standard_Setting_Tech_Report_October_2012.pdf

Given the scale score and the logit standards defining the performance level, it is sufficient to define the final scale score metric. To ensure proper rounding on all future forms, the calculations used 84.501 and 134.501 as the scale score performance standards. The arithmetic was done using logits rounded to four decimals and the final constants for the slope and intercept of the transformation were rounded to five. Scale scores are rounded to whole numbers.

The transformation to scale scores is:

1. $SS = a + b * \text{logit}$ where

2. $b = \dfrac{134.501 - 84.501}{x_E - x_M}$ where x_E is the logit for *Exceeds Standards* and x_M is the logit for *Meets Standards*.

3. $a = 84.501 - bx_M$ or $a = 134.501 - bx_E$.

Calculations of the slopes and intercepts for all grades of the NeSA-R scale score conversion are given in Table 6.2.1, for NeSA-M 6.2.2, and for NeSA-S 6.2.3. The raw-to-scale conversions are provided in Appendices Q, R, and S.

Table 6.2.1 NeSA-R Conversion of Logits to Scale Scores

Grade	Logit Cut Points		Scale Score Ranges by Performance Level			Conversion	
	B/M	M/E	Below	Meets	Exceeds	Slope b	Intercept a
3	-0.5168	1.2340	1 to 84	85-134	135 to 200	28.55837	99.25997
4	-0.5117	0.8591	1 to 84	85-134	135 to 200	36.47505	103.16528
5	-0.4122	0.8560	1 to 84	85-134	135 to 200	39.42751	100.75302
6	-0.4331	0.8924	1 to 84	85-134	135 to 200	37.72161	100.83823
7	-0.5104	0.7855	1 to 84	85-134	135 to 200	38.58471	104.19271
8	-0.4812	0.8712	1 to 84	85-134	135 to 200	36.97131	102.29159
11	-0.4103	0.8508	1 to 84	85-134	135 to 200	39.64793	100.76854

Table 6.2.2 NeSA-M Conversion of Logits to Scale Scores

| Grade | Logit Cut Points | | Scale Score Ranges by Performance Level | | | Conversion | |
	B/M	M/E	Below	Meets	Exceeds	Slope b	Intercept a
3	-0.6000	1.1000	1 to 84	85-134	135 to 200	29.41176	102.15706
4	-0.6000	1.2000	1 to 84	85-134	135 to 200	27.77778	101.17667
5	-0.5700	1.1597	1 to 84	85-134	135 to 200	28.90675	100.98685
6	-0.4700	1.1816	1 to 84	85-134	135 to 200	30.27367	98.73862
7	-0.4500	1.2500	1 to 84	85-134	135 to 200	29.41176	97.74529
8	-0.4000	1.3000	1 to 84	85-134	135 to 200	29.41176	96.27470
11	-0.2900	1.1000	1 to 84	85-134	135 to 200	35.97122	94.94165

Table 6.2.3 NeSA-S Conversion of Logits to Scale Scores

| Grade | Logit Cut Points | | Scale Score Ranges by Performance Level | | | Conversion | |
	B/M	M/E	Below	Meets	Exceeds	Slope b	Intercept a
5	-0.4971	1.0580	1 to 84	85-134	135 to 200	32.15095	100.49331
8	-0.4543	1.0378	1 to 84	85-134	135 to 200	33.50958	99.73252
11	-0.5407	1.3130	1 to 84	85-134	135 to 200	26.97256	99.09502

Complete frequency distributions of the state scale scores for the NeSA-R, NeSA-M, and NeSA-S are provided in Appendices Q, R, and S as part of the raw-to-scale-score conversion tables. A simple summary of the reading, mathematics, and science distributions can be found in Tables 6.2.4, 6.2.5, and 6.2.6.

Table 6.2.4 2013 NeSA-R State Scale Score Summary, All Students

| Grade | Count | Scale Score | | Quartile | | |
		Mean	S.D.	First	Second	Third
3	22712	111.2	33.7	86	110	134
4	22206	114.8	38.5	89	113	139
5	21982	118.4	42.7	88	120	152
6	21651	115.2	42.1	85	114	145
7	21425	122.5	43.2	92	124	156
8	20984	115.7	40.2	89	119	145
11	20911	106.0	45.2	72	107	138

Table 6.2.5 2013 NeSA-M State Scale Score Summary, All Students

| Grade | Count | Scale Score | | Quartile | | |
		Mean	S.D.	First	Second	Third
3	22752	110.2	36.4	84	109	136
4	22238	108.7	35.9	84	107	133
5	22022	109.0	35.3	82	107	133
6	21703	106.5	41.0	77	105	133
7	21464	106.1	38.7	78	105	132
8	21016	102.5	37.9	75	100	125
11	20910	100.5	48.6	62	97	135

Table 6.2.6 2013 NeSA-S State Scale Score Summary, All Students

| Grade | Count | Scale Score | | Quartile | | |
		Mean	S.D.	First	Second	Third
5	22041	104.2	36.8	77	101	129
8	21038	102.8	34.3	77	101	127
11	20900	103.2	30.1	83	102	124

7. FIELD TEST ITEM DATA SUMMARY

As noted in Chapter Two, in addition to the operational items, field test items were embedded in all content areas and grade level assessments in order to expand the item pool for future form development. Field test items are items being administered for the first time to gather statistical information. These items do not count toward an individual student's score. All field tested items were analyzed statistically following classical item analysis methods including proportion correct, point-biserial correlation, and DIF.

7.1 CLASSICAL ITEM STATISTICS

Indices known as classical item statistics included the item *p*-value and the point-biserial correlations for MC items. For MC items, the *p*-value reflects the proportion of students who answered the item correctly. 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. The primary way of detecting such conditions is through the point-biserial correlation coefficient for dichotomous (MC) items. The point-biserial correlation will be positive if the total test mean score is higher for the students who respond correctly to MC items and negative when the reverse is true.

The traditional statistics are computed for each NeSA-R field test item in Appendix F, for NeSA-M Appendix G and NeSA-S Appendix H. Tables 7.1.1, 7.1.2, and 7.1.3 provide summaries of the distributions of item proportion correct and point-biserial correlations. For future form construction, items with negative point-biserial correlations are never considered for operational use. Items with correlations less than 0.2 or proportion correct less than 0.3 or greater 0.9 are avoided when possible.

Table 7.1.1 Summary of Traditional Item Statistics for NeSA-R 2013 Field Test Items

| Grade | Item Proportion Correct | | | | | | | | | | Mean | Total |
	<=0.1	<=0.2	<=0.3	<=0.4	<=0.5	<=0.6	<=0.7	<=0.8	<=0.9	>0.9		
3	0	0	1	4	4	8	15	13	5	0	.630	50
4	1	0	0	0	4	6	11	14	11	3	.703	50
5	0	0	0	1	8	10	8	12	11	0	.667	50
6	0	0	1	1	3	3	11	12	16	3	.731	50
7	0	0	1	5	4	8	13	12	7	0	.635	50
8	0	0	1	1	6	10	5	13	13	1	.672	50
11	0	1	3	3	3	9	9	10	10	2	.638	50

	Item Point-biserial Correlation							
Grade	<=0.1	<=0.2	<=0.3	<=0.4	<=0.5	<=0.6	>0.6	Total
3	0	4	8	19	18	1	0	50
4	1	1	6	25	17	0	0	50
5	0	1	14	17	18	0	0	50
6	0	5	2	23	18	2	0	50
7	2	4	10	12	21	1	0	50
8	0	2	9	19	19	1	0	50
11	2	5	5	16	15	7	0	50

Table 7.1.2 Summary of Traditional Item Statistics for NeSA-M 2013 Field Test Items

	Item Proportion Correct											
Grade	<=0.1	<=0.2	<=0.3	<=0.4	<=0.5	<=0.6	<=0.7	<=0.8	<=0.9	>0.9	Mean	Total
3	0	1	2	4	4	5	10	11	11	2	.651	50
4	0	0	1	2	4	12	6	12	9	4	.672	50
5	0	0	4	5	1	6	5	13	14	2	.663	50
6	0	0	1	2	5	10	12	9	11	0	.647	51
7	0	0	3	0	8	10	10	9	8	2	.638	50
8	0	0	3	4	6	8	10	10	9	0	.625	50
11	0	0	4	3	14	17	6	5	1	0	.529	50

	Item Point-biserial Correlation							
Grade	<=0.1	<=0.2	<=0.3	<=0.4	<=0.5	<=0.6	>0.6	Total
3	0	3	8	23	14	2	0	50
4	0	2	8	21	16	3	0	50
5	1	2	14	16	15	2	0	50
6	0	2	6	15	18	9	0	51
7	0	0	3	18	22	7	0	50
8	0	4	2	16	24	4	0	50
11	1	2	5	14	18	9	1	50

Table 7.1.3 Summary of Traditional Item Statistics for NeSA-S 2013 Field Test Items

Grade	Item Proportion Correct										Mean	Total
	<=0.1	<=0.2	<=0.3	<=0.4	<=0.5	<=0.6	<=0.7	<=0.8	<=0.9	>0.9		
5	0	0	3	3	4	6	7	13	9	5	.675	50
8	0	1	3	5	6	13	8	8	5	1	.575	50
11	1	4	3	7	8	8	6	6	5	2	.524	50

Grade	Item Point-biserial Correlation							Total
	<=0.1	<=0.2	<=0.3	<=0.4	<=0.5	<=0.6	>0.6	
5	1	4	16	16	13	0	0	50
8	4	5	11	19	11	0	0	50
11	5	10	12	15	7	1	0	50

7.2 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*. Items exhibiting DIF were referred to content specialists to determine possible bias. 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.

For MC items, the *Mantel-Haenszel* procedure (Mantel & Haenszel, 1959) for detecting DIF is a commonly used technique in educational testing. 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 minority for ethnicity-based DIF; reference groups were male and white, respectively.

To assist the review committees in interpreting the analyses, the items are assigned a severity code based on the magnitude of the MH 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. Tables 7.2.1 – 7.2.3

show summaries of the DIF statistics. The first column defines the focal group. Appendices T, U, and V provide more summary information on DIF analysis.

Table 7.2.1 Summary of DIF by Code for NeSA-R 2013 Field Test

Grade 3	A+	A-	B+	B-	C+	C-	FT Items
Female	31	18	1	0	0	0	50
Black	8	37	0	5	0	0	50
Hispanic	16	33	0	1	0	0	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	0	0	0	0	0	0	50

Grade 4	A+	A-	B+	B-	C+	C-	FT Items
Female	27	19	2	2	0	0	50
Black	7	35	0	7	0	1	50
Hispanic	20	26	0	3	0	1	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	0	0	0	0	0	0	50

Grade 5	A+	A-	B+	B-	C+	C-	FT Items
Female	31	17	1	1	0	0	50
Black	12	30	0	7	0	1	50
Hispanic	16	30	0	4	0	0	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	0	0	0	0	0	0	50

Grade 6	A+	A-	B+	B-	C+	C-	FT Items
Female	27	23	0	0	0	0	50
Black	13	28	0	5	0	4	50
Hispanic	17	30	1	1	0	1	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	0	0	0	0	0	0	50

Grade 7	A+	A-	B+	B-	C+	C-	FT Items
Female	19	26	3	2	0	0	50
Black	7	38	0	4	0	1	50
Hispanic	13	33	0	1	0	3	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	0	0	0	0	0	0	50

Grade 8	A+	A-	B+	B-	C+	C-	FT Items
Female	29	17	1	2	0	1	50
Black	8	27	0	12	0	3	50
Hispanic	7	36	0	6	0	1	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	0	0	0	0	0	0	50

Grade 11	A+	A-	B+	B-	C+	C-	FT Items
Female	21	26	1	1	0	1	50
Black	9	28	1	8	0	4	50
Hispanic	14	31	0	3	0	2	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	0	0	0	0	0	0	50

Table 7.2.2 Summary of DIF by Code for NeSA-M 2013 Field Test

Grade 3	A+	A-	B+	B-	C+	C-	FT Items
Female	19	30	0	1	0	0	50
Black	11	25	1	11	0	2	50
Hispanic	22	22	1	4	0	1	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	2	5	0	0	0	0	50

Grade 4	A+	A-	B+	B-	C+	C-	FT Items
Female	25	24	1	0	0	0	50
Black	11	31	0	6	0	2	50
Hispanic	17	30	0	2	0	1	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	1	2	0	0	0	0	50

Grade 5	A+	A-	B+	B-	C+	C-	FT Items
Female	31	19	0	0	0	0	50
Black	10	28	0	8	0	4	50

Grade 5	A+	A-	B+	B-	C+	C-	FT Items
Hispanic	18	28	0	2	0	2	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	1	3	0	0	0	0	50

Grade 6	A+	A-	B+	B-	C+	C-	FT Items
Female	31	16	2	1	0	0	50
Black	20	25	0	3	0	2	50
Hispanic	22	23	1	3	0	1	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	0	0	0	0	0	0	50

Grade 7	A+	A-	B+	B-	C+	C-	FT Items
Female	20	28	0	1	0	1	50
Black	6	25	0	16	0	3	50
Hispanic	4	41	0	5	0	0	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	0	0	0	0	0	0	50

Grade 8	A+	A-	B+	B-	C+	C-	FT Items
Female	27	22	1	0	0	0	50
Black	13	29	0	6	0	2	50
Hispanic	17	32	0	1	0	0	50
American Indian/Alaska Native	0	0	0	0	0	0	50

Grade 8	A+	A-	B+	B-	C+	C-	FT Items
Asian	0	0	0	0	0	0	50
2 or more Races	0	0	0	0	0	0	50

Grade 11	A+	A-	B+	B-	C+	C-	FT Items
Female	26	21	2	1	0	0	50
Black	12	35	1	2	0	0	50
Hispanic	16	33	0	1	0	0	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	0	0	0	0	0	0	50

Table 7.2.3 Summary of DIF by Code for NeSA-S 2013 Field Test

Grade 5	A+	A-	B+	B-	C+	C-	FT Items
Female	25	22	1	2	0	0	50
Black	9	31	0	6	0	4	50
Hispanic	16	32	0	2	0	0	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	2	2	0	0	0	0	50

Grade 8	A+	A-	B+	B-	C+	C-	FT Items
Female	25	22	1	1	0	1	50
Black	8	29	2	9	0	2	50
Hispanic	12	31	1	2	0	4	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	0	0	0	0	0	0	50

Grade 11	A+	A-	B+	B-	C+	C-	FT Items
Female	20	19	4	6	1	0	50
Black	11	30	0	7	0	2	50
Hispanic	12	36	0	2	0	0	50
American Indian/Alaska Native	0	0	0	0	0	0	50
Asian	0	0	0	0	0	0	50
2 or more Races	0	0	0	0	0	0	50

8. RELIABILITY

This chapter addresses the reliability of NeSA test scores. According to the *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 1999), reliability refers to

> the degree to which test scores for a group of test takers are consistent over repeated applications of a measurement procedure and hence are inferred to be dependable and repeatable for an individual test taker; the degree to which scores are free of errors of measurement for a given group (p. 25).

8.1 COEFFICIENT ALPHA

The ability to measure consistently is a necessary prerequisite for making appropriate interpretations (i.e., showing evidence of valid use of results). Conceptually, reliability can be referred to as the consistency of the results between two measures of the same thing. This consistency can be seen in the degree of agreement between two measures on two occasions. Operationally, such comparisons are the essence of the mathematically defined reliability indices.

All measures consist of an accurate, or true, component and an inaccurate, or error, component. Errors occur as a natural part of the measurement process and can never be eliminated entirely. For example, uncontrollable factors such as differences in the physical environment and changes in examinee disposition may increase error and decrease reliability. This is the fundamental premise of traditional reliability analysis and measurement theory. Stated explicitly, this relationship can be seen as the following:

$$Observed\ Score = True\ Score + Error \tag{8.1}$$

To facilitate a mathematical definition of reliability, these components can be rearranged to form the following ratio:

$$Reliability = \frac{TrueScoreVariance}{ObservedScoreVariance} = \frac{TrueScoreVariance}{TrueScoreVariance + ErrorScoreVariance} \tag{8.2}$$

When there is no error, the reliability is true score variance divided by true score variance, which equals 1. However, as more error influences the measure, the error component in the denominator of the ratio increases. As a result, the reliability decreases.

The reliability index used for the 2013 administration of the NeSA was the Coefficient Alpha α (Cronbach, 1951). Acceptable α values generally range in the mid to high 0.80s to low 0.90s. The total test Coefficient Alpha reliabilities of the whole population are presented in Table 8.1.1 for each grade and content area of the NeSA. The table contains test length in total number of items (*L*), test reliabilities, and traditional standard errors of measurement (SEM). As can be seen in the table, all reading, mathematics, and science forms for grades 3-11 have Coefficient Alphas in the high 0.80s or

low 0.90s. Overall, these α values provide evidence of good reliability.

Table 8.1.1 Reliabilities and Standard Errors of Measurement

	Grade	L	Reliability	SEM
Reading	3	45	0.90	2.8
	4	45	0.88	2.7
	5	48	0.90	2.9
	6	48	0.90	2.8
	7	48	0.91	2.8
	8	50	0.90	2.9
	11	50	0.91	2.9
Mathematics	3	50	0.92	2.9
	4	55	0.93	3.0
	5	55	0.92	3.1
	6	58	0.94	3.0
	7	58	0.94	3.0
	8	60	0.93	3.3
	11	60	0.95	3.1
Science	5	50	0.90	3.0
	8	60	0.91	3.2
	11	60	0.92	3.2

Reliability estimates for subgroups based on gender, ethnicity, special education status, limited English proficiency status, and food program eligibility status are also computed and reported in Appendix W. Results show fairly high reliability indices for all subpopulations in the high 0.80s to low 0. 90s across grades and content areas, which indicates that the NeSA is not only reliable for the population as a whole, but it is also reliable for subpopulations of interest under NCLB. Appendix X present α for the content strands. Given that α is a function of test length, the smaller item counts for the content standards result in lower values of α which is to be expected. Overall, these two sets of values provide evidence of good reliability.

8.2 STANDARD ERROR OF MEASUREMENT

The traditional SEM uses the information from the test along with an estimate of reliability to make statements about the degree to which error influences individual scores. The SEM is based on the premise that underlying traits, such as academic achievement, cannot be measured exactly without a perfectly precise measuring instrument. The standard error expresses unreliability in terms of the raw-score metric. The SEM formula is provided below:

$$SEM = SD\sqrt{1 - reliability} \tag{8.3}$$

This formula 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). SEMs were calculated for each NeSA grade and content area using raw scores and displayed in Table 8.1.1.

8.3 CONDITIONAL STANDARD ERROR OF MEASUREMENT (CSEM)

The preceding discussion reviews the traditional approach to judging a test's consistency. This approach is useful for making overall comparisons between alternate forms. However, it is not very useful for judging the precision with which a specific student's score is known. The Rasch measurement models provide "conditional standard errors" that pertain to each unique ability estimate. 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.

The complete set of conditional standard errors for every obtainable score can be found in Appendices Q, R and S as part of the raw-to-scale-score conversions for each grade and content area. Values were derived using the calibration data file described in Chapter Six and are on the scaled score metric. The magnitudes of CSEMs across the score scale seemed reasonable for most NeSA tests that the values are lower in the middle of the score range and increase at both extremes (i.e., at smaller and larger scale scores). This is because ability estimates from scores near the center of the test scoring range are known much more precisely than abilities associated with extremely high or extremely low scores. Table 8.3.1 reports the minimum CSEM of the scale score associated with the zero total test score (Min CSEM), the maximum CSEM of the scale score associated with the perfect total test score (Max CSEM), CSEM at the cuts of Below and Meets performance levels (CSEM B/M), and CSEM at the cuts of Meets and Exceeds performance levels (CSEM M/E) for each grade and content area. CSEM values at the cut score were generally associated with smaller CSEM values, indicating that more precise measurement occurs at these cuts.

Table 8.3.1 CSEM of the Scale Scores for 2013 NeSA Tests

	Grade	Min CSEM	Max CSEM	CSEM B/M	CSEM M/E
Reading	3	9	52	9	12
	4	12	67	12	14
	5	12	72	12	14
	6	12	69	12	14
	7	12	71	12	14
	8	11	68	11	14
	11	12	73	12	15
Mathematics	3	9	54	9	12
	4	8	51	8	11
	5	8	53	8	11
	6	8	55	8	12
	7	8	54	8	12
	8	8	54	8	11
	11	10	66	10	13
Science	5	10	59	10	13
	8	9	61	9	12
	11	7	50	7	11

8.4 DECISION CONSISTENCY AND ACCURACY

When criterion-referenced tests are used to place the examinees into two or more performance classifications, it is useful to have some indication of how accurate or consistent such classifications are. 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). Decision accuracy describes the extent to which achievement-level classification decisions based on the administered test form would agree with the decisions that would be made on the basis of a perfectly reliable test. In a standards-based testing program there should be great interest in knowing how consistently and accurately students are classified into performance categories.

Since it is not feasible to repeat NeSA testing in order to estimate the proportion of students who would be reclassified in the same achievement levels, a statistical model needs to be imposed on the data to project the consistency or accuracy of classifications solely using data from the available administration (Hambleton & Novick, 1973). Although a number of procedures are available, two well-known methods were developed by Hanson and Brennan (1990) and Livingston and Lewis (1995) utilizing specific True Score Models. These approaches are fairly complex, and the cited sources

contain details regarding the statistical models used to calculate decision consistency from the single NeSA administration.

Several factors might affect decision consistency. One important factor is the reliability of the scores. All other things being equal, more reliable test scores tend to result in more similar reclassifications. Another factor is the location of the cutscore in the score distribution. More consistent classifications are observed when the cutscores are located away from the mass of the score distribution. The number of performance levels is also a consideration. Consistency indices for four performance levels should be lower than those based on three categories because classification using four levels would allow more opportunity to change achievement levels. Finally, some research has found that results from the Hanson and Brennan (1990) method on a dichotomized version of a complex assessment yield similar results to the Livingston and Lewis method (1995) and the method by Stearns and Smith (2007).

The results for the overall consistency across all three achievement levels are presented in Tables 8.4.1 – 8.4.3. The tabled values, derived using the program *BB-Class* (Brennan, 2004), show that consistency values across the two methods are generally very similar. Across all content areas, the overall decision consistency ranged from the mid 0.80s to the low 0.90s while the decision accuracy ranged from the high 0.80s to the mid 0.90s. If a parallel test were administered, at least 85% or more of students would be classified in the same way. Dichotomous decisions using the Meets cuts (Below/Meets) generally have the highest consistency values and exceeded 0.90 in all cases. The pattern of decision accuracy across different cuts is similar to that of decision consistency.

Table 8.4.1 NeSA-R Decision Consistency Results

Content Area	Grade	Livingston & Lewis				Hanson & Brennan			
		Decision Accuracy		Decision Consistency		Decision Accuracy		Decision Consistency	
		Meets	Exceeds	Meets	Exceeds	Meets	Exceeds	Meets	Exceeds
Reading	3	0.93	0.92	0.90	0.89	0.93	0.92	0.90	0.89
	4	0.93	0.90	0.89	0.86	0.93	0.90	0.90	0.86
	5	0.93	0.90	0.91	0.87	0.93	0.90	0.91	0.87
	6	0.93	0.91	0.90	0.87	0.93	0.91	0.90	0.87
	7	0.94	0.91	0.91	0.87	0.94	0.91	0.92	0.88
	8	0.94	0.89	0.91	0.85	0.94	0.90	0.91	0.86
	11	0.93	0.91	0.90	0.87	0.93	0.91	0.90	0.87

Table 8.4.2 NeSA-M Decision Consistency Results

Content Area	Grade	Livingston & Lewis				Hanson & Brennan			
		Decision Accuracy		Decision Consistency		Decision Accuracy		Decision Consistency	
		Meets	Exceeds	Meets	Exceeds	Meets	Exceeds	Meets	Exceeds
Math	3	0.94	0.92	0.91	0.89	0.94	0.92	0.91	0.89
	4	0.94	0.93	0.91	0.90	0.94	0.93	0.91	0.90
	5	0.93	0.93	0.91	0.90	0.93	0.93	0.91	0.90
	6	0.94	0.93	0.91	0.91	0.94	0.93	0.91	0.91
	7	0.94	0.94	0.91	0.91	0.94	0.94	0.91	0.91
	8	0.93	0.94	0.90	0.91	0.93	0.94	0.90	0.91
	11	0.94	0.95	0.92	0.93	0.94	0.95	0.92	0.93

Table 8.4.3 NeSA-S Decision Consistency Results

Content Area	Grade	Livingston & Lewis				Hanson & Brennan			
		Decision Accuracy		Decision Consistency		Decision Accuracy		Decision Consistency	
		Meets	Exceeds	Meets	Exceeds	Meets	Exceeds	Meets	Exceeds
Science	5	0.92	0.92	0.88	0.89	0.92	0.92	0.89	0.89
	8	0.92	0.93	0.89	0.90	0.92	0.93	0.89	0.90
	11	0.93	0.94	0.90	0.91	0.93	0.94	0.90	0.91

9. VALIDITY

As defined in the *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 1999), validity refers to "the degree to which evidence and theory support the interpretation of test scores entailed by proposed uses of tests" (p. 9). The validity process involves the collection of a variety of evidence to support the proposed test score interpretations and uses. This entire technical report describes the technical aspects of the NeSA tests in support of their score interpretations and uses. Each of the previous chapters contributes important evidence components that pertain to score validation: test development, test scoring, item analysis, Rasch calibration, scaling, and reliability. This chapter summarizes and synthesizes the evidence based on the framework presented in *The Standards*.

9.1 EVIDENCE BASED ON TEST CONTENT

Content validity addresses whether the test adequately samples the relevant material it purports to cover. The NeSA for grades 3 through 11 is a criterion-referenced assessment. The criteria referenced are the Nebraska reading and mathematics content standards. Each assessment was based on and was directly aligned to the Nebraska statewide content standards to ensure good content validity.

For criterion-referenced, standards-based assessment, the strong content validity evidence is derived directly from the test construction process and the item scaling. The item development and test construction process, described above, ensures that every item aligns directly to one of the content standards. This alignment is foremost in the minds of the item writers and editors. As a routine part of item selection prior to an item appearing on a test form, the review committees check the alignment of the items with the standards and make any adjustments necessary. The result is consensus among the content specialists and teachers that the assessment does in fact assess what was intended.

The empirical item scaling, which indicates where each item falls on the logit ability-difficulty continuum, should be consistent with what theory suggests about the items. Items that require more knowledge, more advanced skills, and more complex behaviors should be empirically more difficult than those requiring less. Evidence of this agreement is contained in the item summary tables in Appendices K, L, and M, as well as the success of the Bookmark and Contrasting Groups standard setting processes (in the separate *2010 NeSA-R Standard Setting Technical Report, 2011 NeSA-M Standard Setting Technical Report and 2012 NeSA-S Standard Setting Technical Report*). Panelists participating in the Bookmark process work from an item booklet in which items are ordered by their empirical difficulties. Discussions about placement of the bookmarks almost invariably focus on the knowledge, skills, and behaviors required of each item, and, overall, panelists were comfortable with the item ordering and spacing. Contrasting Groups participants, using their knowledge and experience with their students, placed their students in a corresponding Performance Level.

9.2 EVIDENCE BASED ON INTERNAL STRUCTURE

As described in the *Standards* (1999), internal-structure evidence refers to the degree to which the relationships between test items and test components conform to the construct on which the proposed test interpretations are based.

Item-Test Correlations: Item-test correlations are reviewed in Chapter Four. All values are positive and of acceptable magnitude.

Item Response Theory Dimensionality: Results from principle components analyses are presented in Chapter Five. The NeSA reading, mathematics, and science tests were essentially unidimensional, providing evidence supporting interpretations based on the total scores for the respective NeSA tests.

Strand Correlations: Correlations and disattenuated correlations between strand scores within each content area are presented below. This data can also provide information on score dimensionality that is part of internal-structure evidence. As noted in Chapter Two and also in Table 9.2.1, the NeSA-R tests have two strands (denoted by R.1 and R.2), the NeSA-M tests have four strands (denoted by M.1, M.2, M.3, and M.4), and the NeSA-S have four strands (denoted by S.1, S.2, S.3, and S.4) for each grade and content area.

For each grade, Pearson's correlation coefficients between these strands are reported in Tables 9.2.2.a through 9.2.2.g. The intercorrelations between the strands within the content areas are positive and generally range from moderate to high in value.

Table 9.2.1 NeSA Content Strands

Content	Code	Strand
Reading	R.1	Vocabulary
	R.2	Comprehension
Mathematics	M.1	Number Sense
	M.2	Geometric/Measurement
	M.3	Algebraic
	M.4	Data Analysis/Probability
Science	S.1	Inquiry, the Nature of Science, and Technology
	S.2	Physical Science
	S.3	Life Science
	S.4	Earth and Space Science

Table 9.2.2.a Correlations between Reading and Mathematics Strands for Grade 3

Grade 3	R.1	R.2	M.1	M.2	M.3	M.4
R.1						
R.2	0.74					
M.1	0.64	0.68				
M.2	0.61	0.64	0.73			
M.3	0.58	0.63	0.75	0.66		
M.4	0.52	0.55	0.63	0.54	0.58	

Table 9.2.2.b Correlations between Reading and Mathematics Strands for Grade 4

Grade 4	R.1	R.2	M.1	M.2	M.3	M.4
R.1						
R.2	0.74					
M.1	0.64	0.68				
M.2	0.62	0.64	0.78			
M.3	0.52	0.55	0.70	0.63		
M.4	0.54	0.59	0.67	0.62	0.54	

Table 9.2.2.c Correlations between Reading, Mathematics, and Science Strands for Grade 5

Grade 5	R.1	R.2	M.1	M.2	M.3	M.4	S.1	S.2	S.3	S.4
R.1										
R.2	0.75									
M.1	0.65	0.69								
M.2	0.54	0.56	0.69							
M.3	0.55	0.58	0.73	0.58						
M.4	0.59	0.64	0.73	0.59	0.63					
S.1	0.60	0.67	0.61	0.51	0.53	0.59				
S.2	0.64	0.67	0.66	0.55	0.56	0.61	0.65			
S.3	0.65	0.68	0.61	0.51	0.52	0.58	0.65	0.72		
S.4	0.59	0.62	0.59	0.51	0.50	0.55	0.61	0.67	0.69	

Table 9.2.2.d Correlations between Reading and Mathematics Strands for Grade 6

Grade 6	R.1	R.2	M.1	M.2	M.3	M.4
R.1						
R.2	0.73					
M.1	0.61	0.69				
M.2	0.58	0.65	0.77			
M.3	0.60	0.68	0.79	0.75		
M.4	0.60	0.70	0.76	0.71	0.74	

Table 9.2.2.e Correlations between Reading and Mathematics Strands for Grade 7

Grade 7	R.1	R.2	M.1	M.2	M.3	M.4
R.1						
R.2	0.74					
M.1	0.62	0.69				
M.2	0.56	0.64	0.74			
M.3	0.63	0.71	0.80	0.72		
M.4	0.56	0.65	0.72	0.66	0.69	

Table 9.2.2.f Correlations between Reading, Mathematics, and Science Strands for Grade 8

Grade 8	R.1	R.2	M.1	M.2	M.3	M.4	S.1	S.2	S.3	S.4
R.1										
R.2	0.76									
M.1	0.59	0.67								
M.2	0.57	0.64	0.75							
M.3	0.60	0.70	0.78	0.72						
M.4	0.57	0.65	0.71	0.69	0.70					
S.1	0.62	0.70	0.63	0.62	0.64	0.62				
S.2	0.57	0.62	0.58	0.59	0.57	0.59	0.63			
S.3	0.67	0.71	0.62	0.61	0.62	0.60	0.67	0.67		
S.4	0.60	0.64	0.59	0.60	0.58	0.57	0.63	0.66	0.71	

Table 9.2.2.g Correlations between Reading, Mathematics, and Science Strands for Grade 11

Grade 11	R.1	R.2	M.1	M.2	M.3	M.4	S.1	S.2	S.3	S.4
R.1										
R.2	0.76									
M.1	0.54	0.63								
M.2	0.59	0.68	0.73							
M.3	0.60	0.69	0.78	0.82						
M.4	0.57	0.66	0.67	0.73	0.73					
S.1	0.60	0.70	0.62	0.69	0.68	0.66				
S.2	0.59	0.68	0.62	0.68	0.67	0.67	0.70			
S.3	0.64	0.75	0.62	0.68	0.67	0.66	0.73	0.74		
S.4	0.56	0.65	0.54	0.61	0.59	0.59	0.64	0.68	0.72	

The correlations in Tables 9.2.2.a through 9.2.2.g are based on the observed strand scores. These observed-score correlations are weakened by existing measurement error contained within each strand. As a result, disattenuating the observed correlations can provide an estimate of the relationships

between strands if there is no measurement error. The disattenuated correlation coefficients can be computed from the observed correlations (reported in Tables 9.2.2.a – 9.2.2.g) and the reliabilities for each strand (Spearman, 1904, 1910). Disattenuated correlations very near 1.00 might suggest that the same or very similar constructs are being measured. Values somewhat less than 1.00 might suggest that different strands are measuring slightly different aspects of the same construct. Values markedly less than 1.00 might suggest the strands reflect different constructs.

Tables 9.2.3.a through 9.2.3.g show the corresponding disattenuated correlations for the 2013 NeSA tests for each grade. Given that none of these strands has perfect reliabilities (see Chapter Eight), the disattenuated strand correlations are higher than their observed score counterparts. Some within-content-area correlations are very high (e.g., above 0.95), suggesting that the within-content-area strands might be measuring essentially the same construct. This, in turn, suggests that some strand scores might not provide unique information about the strengths or weaknesses of students.

On a fairly consistent basis, the correlations between the strands within each content area were higher than the correlations between strands across different content areas. In general, within-content-area strand correlations were mostly greater than 0.90, while across-content-area strand correlations generally ranged from 0.73 to 0.91. Such a pattern is expected since the two content area tests were designed to measure different constructs.

Table 9.2.3.a Disattenuated Strand Correlations for Reading and Mathematics: Grade 3

Grade 3	R.1	R.2	M.1	M.2	M.3	M.4
R.1						
R.2	0.94					
M.1	0.82	0.79				
M.2	0.83	0.80	0.92			
M.3	0.82	0.81	0.97	0.93		
M.4	0.82	0.79	0.92	0.85	0.95	

Table 9.2.3.b Disattenuated Strand Correlations for Reading and Mathematics: Grade 4

Grade 4	R.1	R.2	M.1	M.2	M.3	M.4
R.1						
R.2	0.97					
M.1	0.83	0.79				
M.2	0.86	0.81	0.95			
M.3	0.78	0.74	0.92	0.90		
M.4	0.86	0.84	0.94	0.92	0.87	

Table 9.2.3.c Disattenuated Strand Correlations for Reading, Mathematics and Science: Grade 5

Grade 5	R.1	R.2	M.1	M.2	M.3	M.4	S.1	S.2	S.3	S.4
R.1										
R.2	0.95									
M.1	0.82	0.78								
M.2	0.79	0.75	0.92							
M.3	0.83	0.80	1.00	0.92						
M.4	0.85	0.84	0.96	0.91	0.99					
S.1	0.89	0.89	0.81	0.79	0.85	0.90				
S.2	0.88	0.83	0.82	0.80	0.84	0.87	0.95			
S.3	0.87	0.83	0.74	0.73	0.76	0.81	0.92	0.96		
S.4	0.85	0.81	0.77	0.77	0.78	0.82	0.92	0.96	0.95	

Table 9.2.3.d Disattenuated Strand Correlations for Reading and Mathematics: Grade 6

Grade 6	R.1	R.2	M.1	M.2	M.3	M.4
R.1						
R.2	0.96					
M.1	0.82	0.80				
M.2	0.81	0.78	0.96			
M.3	0.82	0.81	0.97	0.95		
M.4	0.84	0.86	0.96	0.93	0.95	

Table 9.2.3.e Disattenuated Strand Correlations for Reading and Mathematics: Grade 7

Grade 7	R.1	R.2	M.1	M.2	M.3	M.4
R.1						
R.2	0.96					
M.1	0.81	0.79				
M.2	0.80	0.80	0.94			
M.3	0.85	0.84	0.95	0.93		
M.4	0.84	0.84	0.95	0.96	0.94	

Table 9.2.3.f Disattenuated Strand Correlations for Reading, Mathematics and Science: Grade 8

Grade 8	R.1	R.2	M.1	M.2	M.3	M.4	S.1	S.2	S.3	S.4
R.1										
R.2	0.97									
M.1	0.79	0.81								
M.2	0.77	0.77	0.95							

Grade 8	R.1	R.2	M.1	M.2	M.3	M.4	S.1	S.2	S.3	S.4
M.3	0.79	0.83	0.96	0.89						
M.4	0.80	0.81	0.92	0.91	0.90					
S.1	0.90	0.91	0.85	0.85	0.86	0.87				
S.2	0.82	0.80	0.78	0.80	0.76	0.82	0.92			
S.3	0.91	0.86	0.78	0.77	0.78	0.79	0.92	0.92		
S.4	0.85	0.81	0.78	0.80	0.75	0.78	0.91	0.94	0.95	

Table 9.2.3.g Disattenuated Strand Correlations for Reading, Mathematics and Science: Grade 11

Grade 11	R.1	R.2	M.1	M.2	M.3	M.4	S.1	S.2	S.3	S.4
R.1										
R.2	1.00									
M.1	0.82	0.81								
M.2	0.80	0.78	0.96							
M.3	0.79	0.78	1.00	0.95						
M.4	0.82	0.80	0.92	0.91	0.89					
S.1	0.88	0.86	0.87	0.88	0.85	0.88				
S.2	0.85	0.83	0.86	0.86	0.82	0.88	0.95			
S.3	0.88	0.88	0.82	0.82	0.79	0.83	0.94	0.95		
S.4	0.86	0.84	0.80	0.81	0.77	0.83	0.93	0.97	0.99	

9.3 EVIDENCE RELATED TO THE USE OF THE RASCH MODEL

Since the Rasch model is the basis of all calibration, scaling, and linking analyses associated with the NeSA, 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 test data. As discussed at length in Chapter Five, the underlying assumptions of Rasch models were essentially met for all the NeSA data, indicating the appropriateness of using the Rasch models to analyze the NeSA data.

In addition, the Rasch model was also used to link different operational NeSA tests across years. The accuracy of the linking also affects the accuracy of student scores and the validity of score uses. DRC Psychometric Services staffers conducted verifications to check the accuracy of the procedures, including item calibration, conversions from the raw score to the Rasch ability estimate, and conversions from the Rasch ability estimates to the scale scores.

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