# An Examination of Item Difficulty by Tier, Domain, and Distribution: NCSC 2015 Administration 

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Center for Assessment

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# An Examination of Item Difficulty by Tier, Domain, and Distribution: NCSC 2015 Administration 

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## Executive Summary

The purpose of this study was to investigate item difficulty based on the spring 2015 NCSC assessment. The focus was on evaluating whether tiers ordered as expected such that tier 1 items were least difficult with increasing difficulty for tiers, 2,3 , and 4 , respectively. We also examined item difficulty by the overall distribution of performance. This investigation should help evaluate the extent to which NCSC's item development approach was successful in producing items that were accessible and appropriately challenging for students that span the range of ability.

We conducted this study in two phases. In the first phase, we analyzed item difficulty based on the pvalue or percent of students who responded correctly. These analyses were conducted 1) by tier, 2) by domain, and 3) by tier and domain combined. We produced these analyses for all fourteen grade and content tests. In phase two, we sought to revisit the item difficulty analyses in phase one to address the impact of guessing. In particular, we wanted to address potential differences in performance due to some multiple choice items having two answer choices compared to those with three choices. To accomplish this, we produced two different calculations in lieu of $p$-values: $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ for a subset of grades and content areas.

Using p-values in phase one, the analyses reveal that item difficulty consistently orders by tier for all grade and content area tests with few exceptions. Of the 14 tests analyzed encompassing 42 adjacent tier comparisons (i.e. $1 / 2,2 / 3$, and $3 / 4$ ), tier 'reversals' occurred in only 4 instances. Modest reversals occurred between tiers 2 and 3 in grades 3 and 4 ELA. Slight reversals occurred between tiers 3 and 4 for grades 5 and 7 math. All other comparisons ordered as described by difficulty, although it was not unusual to observe small differences between tiers 2 and 3. Also noteworthy is that tier 1 items were consistently dissimilar from all other tiers; these items were distinctly less difficult with no exceptions.

Across the content domains, there was little evidence of a pattern of difficulty with the exception that in ELA reading informational text was consistently more difficult across grades. Encouragingly, the ordering of $p$-values by tiers generally holds across content domains. While there is some fluctuation in the overall difficulty of the domains, the tiers typically order within the domains, particularly when comparing tier 1to all other tiers. However, both the paucity of items within each domain by tier and the differences in the proportions of tiers in each domain limit interpretation and suggest more research is prudent.

With respect to the spread of items across the student ability distribution, our analyses show that ELA items tend to cluster in the lower to middle deciles whereas the math items tend to cluster in the middle to upper deciles. These results support the claim that item design and development efforts were successful in producing items that are accessible for a range of student abilities.

In phase two, we observed similar patterns of item order by difficulty corresponding to the tiers. However, the strength of the differences was less pronounced, especially when using P+. That is, the items generally increased in difficulty for higher tiers, but these increases were often very small.
Moreover, although a reversal in difficulty (i.e. the higher tier exhibits lower difficulty) between adjacent tiers was uncommon, there were more reversals using P+ compared to p-value and Adjusted P+. For the eight grade and content tests examined with all three metrics ( p -value, $\mathrm{P}+$, and Adjusted $\mathrm{P}+$ ), we found two reversals in the 24 comparisons using p-value and Adjusted $\mathrm{P}+$ and five reversals using $\mathrm{P}+$. Each of the reversals was very slight in degree.

Overall, the evidence suggests that even when adjusting for the number of response choices, the pattern of increasing difficulty for higher tiers holds, but the differences are less distinct and there are more exceptions. We believe these findings can be helpful to identify the tiers and domains that merit further research to better understand the nature of performance differences and determine if or how changes to item specifications, administration, and/or instruction are warranted.

## Purpose

The National Center and State Collaborative (NCSC) is an alternate assessment designed to measure academic achievement for students with significant cognitive disabilities. Central to the NCSC project is the implementation of a structure for item development designed to produce items across a range of complexity and support for all target content areas. NCSC labelled this the 'tier' structure, which the test reflected in design patterns and task templates that informed item development.

There are four levels to the tier structure. Tier 1 items assess essential understanding of the Core Content Connectors (CCC). These items are the least complex and include the greatest use of non-construct relevant scaffolds. Items in tiers 2, 3, and 4 assess focal knowledge, skills, and abilities (KSA) associated with the CCC. Tier 2 items typically include scaffolds, as do some of the Tier 3 items; however, there is minimal use of scaffolds in Tier 4. As noted, the specifications for each tier call for increasingly complex grade-level coverage of the content as the tiers advance, culminating in the most complex coverage of the focal KSA in Tier 4.

The purpose of this study is to investigate the extent to which the tiers functioned as intended. Specifically, we examine item difficulty for items on the Spring 2015 assessment across tiers, domains, and with respect to overall performance distribution. Primarily, the focus is evaluating whether tiers ordered as expected where tier 1 items were least difficult, with increasing difficulty for tiers 2,3 , and 4 respectively. We also examined difficulty by content domain and by tier for each content domain. The latter set of analyses may indicate whether the tier structure was more effective for some content areas than others.

We also examined item difficulty by the overall distribution of performance. The focus of this investigation was to determine if NCSC's item development approach was successful in producing items that were accessible and appropriately challenging for students that span the range of ability.

## Method

We conducted this study in two phases. In the first phase, we analyzed item difficulty based on the pvalue or percent of students who responded correctly. These analyses were conducted 1) by tier, 2) by domain, and 3) by tier and domain combined. We produced these analyses for all fourteen grade and content tests.

Further, where constructed responses items were included, we separate analyses by multiple choice items and constructed response. Results are presented in tables and figures to summarize findings in each category. We looked to see if the difficulty increases by tiers (i.e. lower p-values) and if this pattern holds for each domain.

Additionally, in phase one of this investigation, we examined the correspondence between item difficulty and the ability distribution for all grades and content areas. Specifically, we divided the performance distribution for each grade and content test into deciles, or ten performance bands of equal density. For example, decile one represents students below the tenth percentile in the distribution; decile two represents students above the tenth percentile but below the twentieth percentile and so forth. If 100 students took the test, we would expect ten students in each decile. The deciles were created with respect to theta estimates, which are linearly related to scale scores.

Then, we 'placed' items into decile bins according to the Item Response Theory (IRT) item difficulty estimates or b parameters. For example, if the tenth decile of performance represents a theta of 2.2 or higher, any item with $\mathrm{a} b$ parameter of 2.2 or higher was assigned to that decile. The idea guiding this approach is that when the IRT difficulty parameter closely matches the student's theta estimate, that item is thought to 'fit' well for that student. We examined results to see if there was a spread of items across deciles.

Results are presented separately for inclusion and exclusion of students with a raw score of zero. A zero score is more accurately classified as a non-measure than as low performance. Therefore, the Lowest Obtainable Scale Score (LOSS) excluded results are likely a more suitable basis for interpretation.

In phase two, we sought to revisit the item difficulty analyses in phase one to address the impact of guessing. In particular, we sought to account for potential differences in performance due to some multiple choice items having two answer choices, the Tier 1 items, compared to those with three choices. To accomplish this, we produced two different calculations in lieu of p -values. The first is simply the p value minus the probability of guessing based on the number of answer choices. This value is termed $\mathrm{P}+.{ }^{1}$ Specifically, a three option multiple choice item is assigned a probability of guessing of .33 . A two option multiple choice item is assigned a probability of guessing of .5 . For example a three option item with a p-value of .77 would have a $\mathrm{P}+$ of .44 (. $77-.33$ ).

We noted that the $\mathrm{P}+$ has a 'ceiling effect' insofar as no item can receive a $\mathrm{P}+$ value greater than 1 minus the adjustment for guessing. For example, a two option item has an upper bound $P+$ of .5 . For this reason, we created another value, the Adjusted $\mathrm{P}+$, in which we simply divide the $\mathrm{P}+$ by the upper bound corresponding to the number of answer choices. For example, a two choice item with a p-value of .80 would be assigned a $\mathrm{P}+$ of $.30(.80-.50)$ and an Adjusted $\mathrm{P}+$ of $.60(.30 / .50)$. A three choice item with a p-value of .80 would be assigned a $\mathrm{P}+$ of .47 (.80-.33) and an adjusted $\mathrm{P}+$ of .70 (.47/.67). Table 1 provides a summary of each method.

| Term | Description |
| :---: | :---: |
| P -value | The percent of students who correctly respond to an item |
| P+ | The percent of students who correctly respond to an item minus the probability of guessing where: <br> - The probability of guessing on a two-choice item is set to .5 <br> - The probability of guessing on a three-choice item is set to .33 $P+=\text { percent correct }- \text { probability of guessing }$ |
| Adjusted P+ | $\mathrm{P}+$ (defined above) divided by the upper limit of the $\mathrm{P}+$, which is one minus the probability of guessing. $\text { Adjusted } P+=\frac{P+}{1-\text { probability of guessing }}$ |

[^0]In phase two, then, we replicated the phase one analyses of item difficulty by tier, by domain, and by tier and domain for the multiple choice items using $\mathrm{P}+$ and Adjusted $\mathrm{P}+$. We produced these analyses for ELA and mathematics in each of grades $3,5,8$, and 11 .

## Phase One Results

Grade 3 ELA

## Item Difficulty by Tier

Grade 3 ELA tier and p-values were examined to determine the percent of students who responded correctly at each level of complexity. Tier 1 items are intended to provide the highest level of support while Tier 4 items provide the least amount of support and are therefore similar to grade level accomplishment. A total of 78 items, representing a combination of 58 multiple choice and 20 constructed response items, were analyzed, both together and separately, to determine the p-values at each tier.

The p-value at Tiers 2, 3, and 4 were similar, ranging from $49 \%$ to $55 \%$ of students who responded correctly. The p-value for Tier 1 was significantly higher with $77 \%$ of students scoring correctly on the 16 items. The highest level of support is provided for Tier1 items; therefore, it is not surprising that the highest percentage of students scoring correctly would be noted on these 16 multiple choice (selected response) items. Tiers 2 and 3 have similar number of combined items at 22 and 28 items, respectively. Tier 4 has 12 items, which is the least number of items. The total p-value for all 78 items combined is 58\%.

The p-value at Tiers 2, 3, and 4 were similar, ranging from $56 \%$ to $61 \%$ of students who responded correctly. The p-value for Tier 1 was higher with $77 \%$ of students responding correctly. As noted above, all 16 Tier1 items are multiple choice and have the highest percentage of students responding correctly. There are 12 items in Tier 2, 23 items in Tier 3, and 7 items in Tier 4. Although the percentage of students responding correctly are similar for Tiers 2,3 , and 4 , there are $1 / 2$ as many items in Tier 2 as in Tier 3 and Tier 4 has half as many items as Tier 1. The total p-value for the 58 MC items is $63 \%$.

No Constructed Response (CR) response items were identified at Tier 1. The p-value at Tiers 2 and 3 were similar, ranging from $46 \%$ to $48 \%$ of students who responded correctly. The p-value for Tier 4 was lower with $33 \%$ of students responding correctly. There are 10 items in Tier 2 which is twice as many as Tiers 3 and 4 , which consist of 5 items in each tier. The total p-value for the 20 CR items is $43 \%$.

Tier 4 Multiple Choice (MC) items have a significantly higher percentage of students scoring correctly with a p-value of $60 \%$, whereas Tier 4 CR items have the lowest percentage of students scoring correctly with a $p$-value of $33 \%$. The five (5) CR items represent those items with the least amount of complexity and support, so it is not surprising to find the lowest percentage of students scoring correctly at this tier. However, Tier 4 MC items had a p-value almost as high as Tier 2 items and higher than Tier 3 items.

## Grade 3 ELA (p-value and

 tier) All Items| Tier | p-value | $\mathbf{N}$ |
| :--- | :---: | ---: |
| Tier 1 | .766250 | 16 |
| Tier 2 | .537727 | 22 |
| Tier 3 | .549286 | 28 |
| Tier 4 | .485833 | 12 |
| Total | .580769 | 78 |

Table 2. Grade 3 ELA (p-value and tier) All Items


Figure 1. Grade 3 ELA (p-value and tier) All Items

Grade 3 ELA (p-value and tier) MC Items

| Tier | p-value | $\mathbf{N}$ |
| :--- | :---: | :---: |
| Tier 1 | .766250 | 16 |
| Tier 2 | .606667 | 12 |
| Tier 3 | .564783 | 23 |
| Tier 4 | .600000 | 7 |
| Total | .633276 | 58 |

_Table 3. Grade 3 ELA (p-value and tier) MC Items


Figure 2. Grade 3 ELA (p-value and tier) MC Items

Grade 3 ELA (p-value
and tier) CR Items

| Tier | p-value | N |
| :--- | :---: | :---: |
| Tier 2 | .455000 | 10 |
| Tier 3 | .478000 | 5 |
| Tier 4 | .326000 | 5 |
| Total | .428500 | 20 |

Table 4. Grade 3 ELA (p-value and tier) CR Items


Figure 3. Grade 3 ELA (p-value and tier) CR Items

## Item Difficulty by Domain

We examined grade 3 ELA domains and p-values to determine the percent of students who responded correctly for each domain. A total of 78 items, which represent a combination of 58 multiple choice and 20 constructed response items, were analyzed, both together and separately, to determine the p-values for each of the six domains, which include:

- Foundational Reading at the Word Level (20 items)
- Reading at Word Level (7 items)
- Reading Informational Text (22 items)
- Reading Literature (19 items)
- Writing Informational (4 items)
- Writing Prompt-Narrative (6 items)

The p-value for all domains, except Foundational-Reading at Word Level, were similar, ranging from $60 \%$ to $69 \%$ of the students responding correctly, with Reading at the Word Level having the highest pvalue ( $69 \%$ ) and Reading Informational Text at the lowest ( $60 \%$ ). Reading Literature Domain had $63 \%$ of the students responding correctly, Writing Informational had a p-value of $68 \%$, and Writing PromptNarrative had a $p$-value of $68 \%$. The total $p$-value for all items is $58 \%$.

Although the percentage of students responding correctly are similar for all MC items, there are approximately $1 / 4$ as many items in the Reading at Word Level (7) and Writing domains (informational and literature), 4 and 6 items respectively, than the Reading (informational and literature) domains, with 22 and 19 items, respectively.

Foundational-Reading at the Word Level had the lowest p-value of all domains at 43\%; however, it is important to note that the 20 items in this domain are constructed response items.

| Grade 3 ELA (p-value and domain) - All Items |  |  |  |
| :--- | :---: | ---: | :---: |
| Domain | p-value | N |  |
| Foundational-Reading at Word Level | .428500 | 20 |  |
| Reading at Word Level | .685714 | 7 |  |
| Reading Informational Text | .597727 | 22 |  |
| Reading Literature | .629474 | 19 |  |
| Writing Informational | .685000 | 4 |  |
| Writing Prompt-Narrative | .680000 | 6 |  |
| Total | .580769 | 78 |  |

Table 5. Grade 3 ELA ( $p$-value and domain) - All Items


Figure 4. Grade 3 ELA (p-value and domain) - All Items

Grade 3 ELA (p-value and domain) MC Items

| Domain | p-value | N |
| :--- | ---: | ---: |
| Reading at Word Level | .685714 | 7 |
| Reading Informational Text | .597727 | 22 |
| Reading Literature | .629474 | 19 |
| Writing Informational | .685000 | 4 |
| Writing Prompt-Narrative | .680000 | 6 |
| Total | .633276 | 58 |

[^1]Grade 3 ELA (p-value and domain) - MC Items


Figure 5. Grade 3 ELA (p-value and domain) MC Items

Grade 3 ELA (p-value and domain) - CR Items

| Domain | p-value | N |
| :--- | :---: | ---: |
| Foundational-Reading at Word Level | .428500 | 20 |
| Total | .428500 | 20 |

Table 7. Grade 3 ELA (p-value and domain) - CR Items

## Item Difficulty by Domain and Tier

Grade 3 ELA p-value of domain by tier was examined to determine the percent of students who responded correctly for each domain at each tier level. A total of 78 items, which represent a combination of 58 multiple choice and 20 constructed response items, were analyzed, both together and separately.

The total p -value for the domains in Tier 1 are higher than any other tier with a total p -value at $77 \%$, with p-values at $54 \%$ for the domains in Tier 2, $55 \%$ for the domains in Tier 3, and $48 \%$ for the domains in Tier 4, and a total p-value of $58 \%$ for all domains and all tiers. It is important to note the following:

- there are 0 Foundational-Reading at the Word Level Domain items found in Tier 1, and twice as many items in Tier 2 (10) than Tiers 3 and 4 (5)
- there is only 1 item in tiers 1,2 , and 4 for the Reading at the Word Level Domain, with 4 items in tier 3
- there are 0 items for the Reading Informational Domain in Tier 4, and Tier 1 consists of $1 / 2$ as many items (4) as Tier 2 and Tier 3 (10, 8 respectively)
- there are 0 items for the Reading Literature Domain in Tier 2, with Tier 3 consisting of twice as many items(10) as Tiers 1 and 4 (4, 5, respectively)
- there is only 1 item in each of the 4 tiers for the Writing Informational Domain,
- there are 0 items for the Writing Prompt Narrative Domain in Tiers 2, 3, and 4, with all 6 items in Tier 1

Based on the above data, there is a broad range of the number of items in the different domains at each tier and across tiers. For example, there are 4 items in the Reading Informational Text Domain at Tier 1, 10 items of the same domain in Tier 2, 8 items in Tier 3, and 0 at Tier 4. In addition, there are some tiers that do not contain all of the domains.

The MC items in the domains at Tier 1 has a total p-value of $77 \%$, which is the highest number of students who responded correctly, a total p-value of $61 \%$ at Tier 2 , a total $p$-value of $56 \%$ at Tier 3, and a total p-value of $60 \%$ at Tier 4 , with an overall p-value of $63 \%$ for domains by tier of all MC items.

The CR items are in the Domain of Foundational-Reading at the Word Level in Tiers 2, 3, and 4. The highest p-value is found in Tier 3 at $48 \%$, with a p-value of $45 \%$ at Tier 2 and $33 \%$ at Tier 4. The total pvalue for the CR items is $43 \%$. As noted above, there are twice as many items in Tier 2 than Tiers 3 and 4 .

|  | F-RWL | RWL | RI | RL | WI | WP-N |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 0 | 1 | 4 | 4 | 1 | 6 |
| Tier 2 | 10 | 1 | 10 | 0 | 1 | 0 |
| Tier 3 | 5 | 4 | 8 | 10 | 1 | 0 |
| Tier 4 | 5 | 1 | 0 | 5 | 1 | 0 |

Grade 3 ELA (p-value of domain by tier) - All Items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Reading at Word Level | . 890000 | 1 |
|  | Reading Informational Text | . 797500 | 4 |
|  | Reading Literature | . 815000 | 4 |
|  | Writing Informational | . 840000 | 1 |
|  | Writing Prompt-Narrative | . 680000 | 6 |
|  | Total | . 766250 | 16 |
| Tier 2 | Foundational-Reading at Word Level | . 455000 | 10 |
|  | Reading at Word Level | . 760000 | 1 |
|  | Reading Informational Text | . 574000 | 10 |
|  | Writing Informational | . 780000 | 1 |
|  | Total | . 537727 | 22 |
| Tier 3 | Foundational-Reading at Word Level | . 478000 | 5 |
|  | Reading at Word Level | . 662500 | 4 |
|  | Reading Informational Text | . 527500 | 8 |
|  | Reading Literature | . 557000 | 10 |
|  | Writing Informational | . 550000 | 1 |
|  | Total | . 549286 | 28 |
| Tier 4 | Foundational-Reading at Word Level | . 326000 | 5 |
|  | Reading at Word Level | . 500000 | 1 |
|  | Reading Literature | . 626000 | 5 |
|  | Writing Informational | . 570000 | 1 |
|  | Total | . 485833 | 12 |
| Total | Foundational-Reading at Word Level | . 428500 | 20 |
|  | Reading at Word Level | . 685714 | 7 |
|  | Reading Informational Text | . 597727 | 22 |
|  | Reading Literature | . 629474 | 19 |
|  | Writing Informational | . 685000 | 4 |
|  | Writing Prompt-Narrative | . 680000 | 6 |
|  | Total | . 580769 | 78 |

Table 9. Grade 3 ELA (p-value of domain by tier) - All Items

|  | ELA, Grade 3 |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Writing Prompt-Narrative | $\begin{gathered} 0.68 \\ (6) \end{gathered}$ |  |  |  | P -Value |
| Writing Informational | $0.84$ <br> (1) | $0.78$ <br> (1) | $\begin{gathered} 0.55 \\ (1) \end{gathered}$ | $\begin{gathered} 0.57 \\ (1) \end{gathered}$ |  |
| Reading Literature | $0.82$ <br> (4) |  | $\begin{aligned} & 0.56 \\ & (10) \end{aligned}$ | 0.63 <br> (5) |  |
| Reading Informational Text | 0.8 <br> (4) | $\begin{aligned} & 0.57 \\ & (10) \end{aligned}$ | 0.53 <br> (8) |  | 0.5 |
| Reading at Word Level | $\begin{gathered} 0.89 \\ (1) \end{gathered}$ | $0.76$ <br> (1) | 0.66 <br> (4) | $\begin{aligned} & 0.5 \\ & (1) \end{aligned}$ | 0.4 |
| Foundational-Reading at Word Level |  | $\begin{aligned} & 0.46 \\ & (10) \end{aligned}$ | 0.48 <br> (5) | $\begin{gathered} 0.33 \\ (5) \end{gathered}$ | - -0.3 |
|  | 1 | 2 | 3 | 4 |  |

Figure 6. Grade 3 ELA Heat map of P-Value by Domain and Tier

## Grade 3 ELA (p-value of domain by tier) - MC Items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Reading at Word Level | . 890000 | 1 |
|  | Reading Informational Text | . 797500 | 4 |
|  | Reading Literature | . 815000 | 4 |
|  | Writing Informational | . 840000 | 1 |
|  | Writing Prompt-Narrative | . 680000 | 6 |
|  | Total | . 766250 | 16 |
| Tier 2 | Reading at Word Level | . 760000 | 1 |
|  | Reading Informational Text | . 574000 | 10 |
|  | Writing Informational | . 780000 | 1 |
|  | Total | . 606667 | 12 |
| Tier 3 | Reading at Word Level | . 662500 | 4 |
|  | Reading Informational Text | . 527500 | 8 |
|  | Reading Literature | . 557000 | 10 |
|  | Writing Informational | . 550000 | 1 |
|  | Total | . 564783 | 23 |
| Tier 4 | Reading at Word Level | . 500000 | 1 |
|  | Reading Literature | . 626000 | 5 |
|  | Writing Informational | . 570000 | 1 |
|  | Total | . 600000 | 7 |
| Total | Reading at Word Level | . 685714 | 7 |
|  | Reading Informational Text | . 597727 | 22 |
|  | Reading Literature | . 629474 | 19 |
|  | Writing Informational | . 685000 | 4 |
|  | Writing Prompt-Narrative | . 680000 | 6 |
|  | Total | . 633276 | 58 |

Table 10. Grade 3 ELA (p-value of domain by tier) - MC Items

Grade 3 ELA ( $p$-value of domain by tier) - CR Items

| Tier | Domain | p-value | N |
| :--- | :--- | :--- | ---: |
| Tier 2 | Foundational-Reading at Word Level | .455000 | 10 |
|  | Total | .455000 | 10 |
| Tier 3 | Foundational-Reading at Word Level | .478000 | 5 |
|  | Total | .478000 | 5 |
| Tier 4 | Foundational-Reading at Word Level | .326000 | 5 |
|  | Total | .326000 | 5 |
| Total | Foundational-Reading at Word Level | .428500 | 20 |
|  | Total | .428500 | 20 |

Table 11. Grade 3 ELA (p-value of domain by tier) - CR Items

## Distribution of Items

An analysis of the 77 items in grade 3 ELA shows a good spread of items across all deciles. With the LOSS included, there are no items in decile one as expected. However, adjusting to exclude these scores reveals a spread of items across deciles 1 through 6, with fewer items in deciles 7-10.

Grade 3 ELA Items by Decile

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 0 | 0 |
| 2 | 9 | 11.7 |
| 3 | 14 | 18.2 |
| 4 | 12 | 15.6 |
| 5 | 10 | 13.0 |
| 6 | 12 | 15.6 |
| 7 | 8 | 10.4 |
| 8 | 6 | 7.8 |
| 9 | 4 | 5.2 |
| 10 | 2 | 2.6 |
| Total | 77 | 100.0 |

Table 12. Grade 3 ELA Items by Decile


Figure 7. Grade 3 ELA Items by Decile

Grade 3 ELA Items by Decile - LOSS Excluded

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 9 | 11.6 |
| 2 | 10 | 13.0 |
| 3 | 11 | 14.3 |
| 4 | 12 | 15.6 |
| 5 | 8 | 10.4 |
| 6 | 13 | 16.9 |
| 7 | 2 | 2.6 |
| 8 | 6 | 7.8 |
| 9 | 4 | 5.2 |
| 10 | 2 | 2.6 |
| Total | 77 | 100.0 |

Table 13. Grade 3 ELA Items by Decile LOSS Excluded


Figure 8. Grade 3 ELA Items by Decile LOSS Excluded.

Grade 4 ELA

## Item Difficulty by Tier

Grade 4 ELA tier and p-values were examined to determine the percent of students who responded correctly at each level of complexity. Tier 1 items are intended to provide the highest level of support while Tier 4 items provide the least amount of support and are therefore similar to grade level accomplishment. A total of 82 items, which represent a combination of 62 multiple choice and 20 constructed response items, were analyzed, both together and separately, to determine the p-values at each tier.

The p-value at Tiers 2 and 3 were similar, with p-values at $53 \%$ and $55 \%$ of students who responded correctly, respectively. The p-value for Tier 4 was slightly lower, with $43 \%$ of the students responding correctly on the 13 items. The p -value for Tier 1 was significantly higher, with $77 \%$ of the students responding correctly on the 18 items. The highest level of support is provided for Tier1 items; therefore, it is not surprising that all 18 items are multiple choice items (selected response) and that this tier has the highest p-value. Tier 2 has a total number of 21 combined items and Tier 3 has a total number of 30 combined items.

The p-value at Tiers 2, 3, and 4 were similar, ranging from $53 \%$ to $56 \%$ of students who responded correctly. The p-value for Tier 1 was higher with $77 \%$ of students responding correctly. As noted above, all 18 Tier1 items are multiple choice and have the highest percentage of students responding correctly. There are 11 items in Tier 2, 25 items in Tier 3, and 8 items in Tier 4. Although the percentage of students responding correctly are similar for Tiers 2,3 , and 4 , Tier 2 has $1 / 2$ as many items as Tier 3 , and Tier 4 has half as many items as Tier 2. The total p-value for the 62 MC items is $61 \%$.

No CR response items were identified at Tier 1. The p-value at Tiers 2 and 3 were the same at $50 \%$ of the students responding correctly. The p-value for Tier 4 was significantly lower with $28 \%$ of students responding correctly. There are 10 items in Tier 2, and exactly $1 / 2$ as many items in Tier 3 and Tier 4 ( 5 items). The total p -value for the 20 CR items is $45 \%$.

Tier 4 MC and CR have the lowest percentage of students responding correctly, with a p-value of $53 \%$ and $28 \%$, respectively. Items in Tier 4 represent those items with the least amount of complexity and support, so it is not surprising to find the lowest percentage of students responding correctly at this tier.

## Grade 4 ELA (p-value and

 tier) All Items| Tier | p-value | $\mathbf{N}$ |
| :--- | :--- | ---: |
| Tier 1 | .767778 | 18 |
| Tier 2 | .530952 | 21 |
| Tier 3 | .550333 | 30 |
| Tier 4 | .433077 | 13 |
| Total | .574512 | 82 |

Table 14. Grade 4 ELA (p-value and tier) All Items


Figure 9. Grade 4 ELA (p-value and tier) All Items

Grade 4 ELA (p-value and tier) MC Items

| Tier | p-value | N |
| :--- | :---: | ---: |
| Tier 1 | .767778 | 18 |
| Tier 2 | .557273 | 11 |
| Tier 3 | .560000 | 25 |
| Tier 4 | .530000 | 8 |
| Total | .615968 | 62 |

Table 15. Grade 4 ELA (p-value and tier) MC Items


Figure 10. Grade 4 ELA (p-value and tier) MC Items

## ELA (p-value and tier) CR

Items

| Tier | p-value | $\mathbf{N}$ |
| :--- | :---: | ---: |
| Tier 2 | .502000 | 10 |
| Tier 3 | .502000 | 5 |
| Tier 4 | .278000 | 5 |
| Total | .446000 | 20 |

Table 16. Grade 4 ELA (p-value and tier) CR Items


Figure 11. Grade 4 ELA (p-value and tier) CR Items

## Item Difficulty by Domain

We examined grade 4 ELA domains and p-values to determine the percent of students who responded correctly for each domain. A total of 82 items, which represent a combination of 62 multiple choice and 20 constructed response items, were analyzed, both together and separately, to determine the p-values for each of the six domains, which include:

- Foundational Reading at the Word Level (23 items)
- Reading at Word Level (5 items)
- Reading Informational Text (23 items)
- Reading Literature (23 items)
- Writing Informational (4 items)
- Writing Prompt-Narrative (4 items)

The p-value for all domains, except Foundational-Reading at Word Level and Writing Prompt-Narrative, were similar, ranging from $56 \%$ to $63 \%$ of students responding correctly, with Reading Informational Text having the lowest p-value (56\%) and Reading Literature having the highest (63\%). Both of these domains include 23 MC items.

Although the percentage of students responding correctly for these domains, are similar for all MC items, there are approximately $1 / 6$ as many items in the Reading at Word Level (5) and Writing domains (informational and literature), 5 items, than the Reading (informational and literature) domains, with 4 items each.

Foundational-Reading at the Word Level had the lowest p-value of all domains at 49\%; however, it is important to note that 20 items in this domain are constructed response items and 3 of the items are multiple choice. The 20 items are the only items that are CR. Writing Prompt-Narrative had the highest p-value at $72 \%$.

## Grade 4 ELA (p-value and domain) - All Items

| Domain | p-value | N |
| :--- | :---: | ---: |
| Foundational-Reading at Word | .488696 | 23 |
| Level | .616000 | 5 |
| Reading at Word Level | .564783 | 23 |
| Reading Informational Text | .632609 | 23 |
| Reading Literature | .587500 | 4 |
| Writing Informational | .725000 | 4 |
| Writing Prompt-Narrative | .574512 | 82 |
| Total |  |  |

Table 17. Grade 4 ELA (p-value and domain) - All Items


Figure 12. Grade 4 ELA (p-value and domain) - All Items

Grade 4 ELA (p-value and domain) MC Items

| Domain | p-value | N |
| :--- | :---: | ---: |
| Foundational-Reading at Word Level | .773333 | 3 |
| Reading at Word Level | .616000 | 5 |
| Reading Informational Text | .564783 | 23 |
| Reading Literature | .632609 | 23 |
| Writing Informational | .587500 | 4 |
| Writing Prompt-Narrative | .725000 | 4 |
| Total | .615968 | 62 |

Table 18. Grade 4 ELA (p-value and domain) MC Items


Figure 13. Grade 4 ELA (p-value and domain) MC Items

## Grade 4 ELA (p-value and domain) - CR Items

| Domain | p-value | N |
| :--- | :---: | :---: |
| Foundational-Reading at Word Level | .446000 | 20 |
| Total | .446000 | 20 |

Table 19. Grade 4 ELA (p-value and domain) - CR Items

## Item Difficulty by Domain and Tier

We examine Grade 4 ELA p-value of domain by tier to determine the percent of students who responded correctly for each domain at each tier level. A total of 82 items, which represent a combination of 62 multiple choice and 20 constructed response items, were analyzed, both together and separately.

The total p -value for the domains in Tier 1 are higher than any other tier with a total p -value at $77 \%$ and p-values at $53 \%$ for the domains in Tier 2, $55 \%$ for the domains in Tier 3, and $43 \%$ for the domains in Tier 4. The number of students who responded correctly for the domains in each tier is similar to the pvalues in grade 3 . It is important to note the following:

- each of the tiers contain Foundational-Reading at Word Level items, with Tier 2 containing the majority of items (10) compared to the other tiers, with 3 items in Tier 1 and 5 items in both Tiers 3 and 4
- there is only 1 item in tiers 1,2 , and 4 for the Reading at the Word Level Domain, with 2 items in tier 3
- there are 0 items for the Reading Informational Domain in Tier 4 and 4 items for this domain in Tier 1, with Tiers 2 and 3 containing more than twice as many items, 9 and 10 , respectively
- there are 0 items for the Reading Literature Domain in Tier 2 (this is similar to grade 3), with 12 items in Tier 3 and half the number in Tiers 1 and 4 (5 and 6, respectively)
- there is only 1 item in each of the 4 tiers for the Writing Informational Domain, also similar to grade 3
- all 4 items in the Writing Prompt Narrative Domain are found in Tier 1, also similar to grade 3

Based on the above data, there is a broad range of the number of items in the different domains at each tier and across tiers. For example, there are 4 items in the Reading Informational Text Domain at Tier 1, 9 and 10 items of the same domain in Tiers 2 and 3, and 0 at Tier 4.

The MC items in the domains at Tier 1 have a total p-value of $77 \%$, which is the highest number of students responding correctly, a p-value of $56 \%$ at Tier 2, a p-value of $56 \%$ at Tier 3, and a p-value of $53 \%$ at Tier 4.

The CR items are in the Domain of Foundational-Reading at the Word Level in Tiers 2, 3, and 4. The highest p-value is found in Tiers 2 and 3 at $50 \%$ and a p-value of $28 \%$ at Tier 4. The total p-value for CR items is $45 \%$. As noted above, there are twice as many items in Tier 2 than Tiers 3 and 4.

|  | F-RWL | RWL | RI | RL | WI | WP-N |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 3 | 1 | 4 | 5 | 1 | 4 |
| Tier 2 | 10 | 1 | 9 | 0 | 1 | 0 |
| Tier 3 | 5 | 2 | 10 | 12 | 1 | 0 |
| Tier 4 | 5 | 1 | 0 | 6 | 1 | 0 |

Table 20. Grade 4 ELA Items by Domain and Tier
Grade 4 ELA (p-value of domain by tier) - All Items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Foundational-Reading at Word Level | . 773333 | 3 |
|  | Reading at Word Level | . 720000 | 1 |
|  | Reading Informational Text | . 780000 | 4 |
|  | Reading Literature | . 810000 | 5 |
|  | Writing Informational | . 710000 | 1 |
|  | Writing Prompt-Narrative | . 725000 | 4 |
|  | Total | . 767778 | 18 |
| Tier 2 | Foundational-Reading at Word Level | . 502000 | 10 |
|  | Reading at Word Level | . 470000 | 1 |
|  | Reading Informational Text | . 562222 | 9 |
|  | Writing Informational | . 600000 | 1 |
|  | Total | . 530952 | 21 |
| Tier 3 | Foundational-Reading at Word Level | . 502000 | 5 |
|  | Reading at Word Level | . 665000 | 2 |
|  | Reading Informational Text | . 481000 | 10 |
|  | Reading Literature | . 605000 | 12 |
|  | Writing Informational | . 600000 | 1 |
|  | Total | . 550333 | 30 |
| Tier 4 | Foundational-Reading at Word Level | . 278000 | 5 |
|  | Reading at Word Level | . 560000 | 1 |
|  | Reading Literature | . 540000 | 6 |
|  | Writing Informational | . 440000 | 1 |
|  | Total | . 433077 | 13 |
| Total | Foundational-Reading at Word Level | . 488696 | 23 |
|  | Reading at Word Level | . 616000 | 5 |
|  | Reading Informational Text | . 564783 | 23 |
|  | Reading Literature | . 632609 | 23 |
|  | Writing Informational | . 587500 | 4 |
|  | Writing Prompt-Narrative | . 725000 | 4 |
|  | Total | . 574512 | 82 |

Table 21. Grade 4 ELA (p-value of domain by tier) - All Items

## Grade 4 ELA (p-value of domain by tier) - All Items

|  | ELA, Grade 4 |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Writing Prompt-Narrative | $\begin{gathered} 0.72 \\ (4) \end{gathered}$ |  |  |  | P -Value |
| Writing Informational | $0.71$ (1) | $\begin{aligned} & 0.6 \\ & (1) \end{aligned}$ | $\begin{aligned} & 0.6 \\ & (1) \end{aligned}$ | 0.44 <br> (1) |  |
| Reading Literature | $\begin{gathered} 0.81 \\ (5) \end{gathered}$ |  | $\begin{gathered} 0.6 \\ (12) \end{gathered}$ | $\begin{gathered} 0.54 \\ (6) \end{gathered}$ |  |
| Reading Informational Text | $\begin{gathered} 0.78 \\ (4) \end{gathered}$ | $\begin{gathered} 0.56 \\ (9) \end{gathered}$ | $\begin{aligned} & 0.48 \\ & (10) \end{aligned}$ |  |  |
| Reading at Word Level | $\begin{gathered} 0.72 \\ (1) \end{gathered}$ | $0.47$ (1) | $\begin{gathered} 0.66 \\ (2) \end{gathered}$ | $\begin{gathered} 0.56 \\ (1) \end{gathered}$ | 0.4 |
| Foundational-Reading at Word Level | $\begin{aligned} & 0.77 \\ & (3) \end{aligned}$ | $\begin{gathered} 0.5 \\ (10) \end{gathered}$ | $\begin{aligned} & 0.5 \\ & (5) \end{aligned}$ | $\begin{gathered} 0.28 \\ \text { (5) } \end{gathered}$ | 0.3 |
|  | 1 | 2 | 3 | 4 |  |

Figure 14. Grade 4 ELA Heat Map of P-Value by Domain and Tier

## Grade 4 ELA (p-value of domain by tier) - MC Items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Foundational-Reading at Word Level | . 773333 | 3 |
|  | Reading at Word Level | . 720000 | 1 |
|  | Reading Informational Text | . 780000 | 4 |
|  | Reading Literature | . 810000 | 5 |
|  | Writing Informational | . 710000 | 1 |
|  | Writing Prompt-Narrative | . 725000 | 4 |
|  | Total | . 767778 | 18 |
| Tier 2 | Reading at Word Level | . 470000 | 1 |
|  | Reading Informational Text | . 562222 | 9 |
|  | Writing Informational | . 600000 | 1 |
|  | Total | . 557273 | 11 |
| Tier 3 | Reading at Word Level | . 665000 | 2 |
|  | Reading Informational Text | . 481000 | 10 |
|  | Reading Literature | . 605000 | 12 |
|  | Writing Informational | . 600000 | 1 |
|  | Total | . 560000 | 25 |
| Tier 4 | Reading at Word Level | . 560000 | 1 |
|  | Reading Literature | . 540000 | 6 |
|  | Writing Informational | . 440000 | 1 |
|  | Total | . 530000 | 8 |
| Total | Foundational-Reading at Word Level | . 773333 | 3 |
|  | Reading at Word Level | . 616000 | 5 |
|  | Reading Informational Text | . 564783 | 23 |
|  | Reading Literature | . 632609 | 23 |
|  | Writing Informational | . 587500 | 4 |
|  | Writing Prompt-Narrative | . 725000 | 4 |
|  | Total | . 615968 | 62 |

Table 22. Grade 4 ELA (p-value of domain by tier) - MC Items

## Grade 4 ELA (p-value of domain by tier) - CR Items

| Tier | Domain | p-value | N |
| :--- | :--- | :---: | ---: |
| Tier 2 | Foundational-Reading at Word Level | .502000 | 10 |
|  | Total | .502000 | 10 |
| Tier 3 | Foundational-Reading at Word Level | .502000 | 5 |
|  | Total | .502000 | 5 |
| Tier 4 | Foundational-Reading at Word Level | .278000 | 5 |
|  | Total | .278000 | 5 |
| Total | Foundational-Reading at Word Level | .446000 | 20 |
|  | Total | .446000 | 20 |

Table 23. Grade 4 ELA (p-value of domain by tier) - CR Items

## Distribution of Items

An analysis of the 82 items in grade 4 ELA shows a good spread of items across all but the highest deciles. With the LOSS included, there are no items in decile one. However, adjusting to exclude these scores, reveals a spread of items across deciles 1 through 7 , with fewer items in deciles 8-10.

Grade 4 ELA Items by Decile

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 0 | 0 |
| 2 | 7 | 8.5 |
| 3 | 14 | 17.1 |
| 4 | 13 | 15.9 |
| 5 | 15 | 18.3 |
| 6 | 16 | 19.5 |
| 7 | 9 | 11.0 |
| 8 | 3 | 3.7 |
| 9 | 4 | 4.9 |
| 10 | 1 | 1.2 |
| Total | 82 | 100.0 |



Figure 15. Grade 4 ELA Items by Decile

Grade 4 ELA Items by Decile LOSS Excluded

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 7 | 8.536585 |
| 2 | 10 | 12.2 |
| 3 | 15 | 18.3 |
| 4 | 9 | 11.0 |
| 5 | 15 | 18.3 |
| 6 | 12 | 14.6 |
| 7 | 7 | 8.5 |
| 8 | 3 | 3.7 |
| 9 | 3 | 3.7 |
| 10 | 1 | 1.2 |
| Total | 82 | 100.0 |

Table 25. Grade 4 ELA Items by Decile LOSS Excluded.


Figure 16. Grade 4 ELA Items by Decile LOSS Excluded

## Grade 5 ELA

## Item Difficulty by Tier

We examined grade 5 ELA tier and p-values to determine the percent of students who responded correctly at each level of complexity. Tier 1 items are intended to provide the highest level of support while Tier 4 items provide the least amount of support and are therefore similar to grade level accomplishment. A total of 61 items were analyzed, all of which are MC items, to determine the p-values at each tier. Unlike grades 3 and 4, there are no CR items in grade 5 .

The p-value at Tiers 2, 3, and 4 were similar, with p-values at $53 \%$ for Tier 2, $52 \%$ at Tier 3, and $49 \%$ at Tier 4. The p -value for Tier 1 was significantly higher, with $77 \%$ of the students responding correctly on the 14 items. The highest level of support is provided for Tier1 items; therefore, it is not surprising that the 14 items have the highest percentage of students responding correctly. Tier 2 has a total number of 12 items, Tier 3 has a total number of 27 items, and Tier 4 has a total number of 8 items. The total p-value for the 61 items is $58 \%$

Although the percentage of students responding correctly are similar for Tiers 2, 3, and 4, Tier 2 has $1 / 2$ as many items as Tier 3, and Tier 4 has $1 / 3$ as many items as Tier 3.

Grade 5 ELA (p-value and tier) All Items

| Tier | p-value | N |
| :--- | :---: | ---: |
| Tier 1 | .768571 | 14 |
| Tier 2 | .531667 | 12 |
| Tier 3 | .524444 | 27 |
| Tier 4 | .492500 | 8 |
| Total | .577705 | 61 |

Table 26. Grade 5 ELA (p-value and tier) All Items


Figure 17. Grade 5 ELA (p-value and tier) All Items

## Item Difficulty by Domain

We examined grade 5 ELA domains and p-values to determine the percent of students who responded correctly for each domain. A total of 61 items were analyzed to determine the p-values for each of the five domains, which include:

- Reading at Word Level (8 items)
- Reading Informational Text (21 items)
- Reading Literature (24 items)
- Writing Informational (4 items)
- Writing Prompt-Narrative (4 items)

There are no items at the Foundational-Reading at the Word Level Domain for grade 5.
The p-value for all domains, except Writing Prompt-Narrative, were similar, with $56 \%$ of the students responding correctly at the Reading at Word Level Domain, 54\% of the students responding correctly at Reading Informational Text Domain, $58 \%$ of students responding correctly at Reading Literature Text Domain, and $61 \%$ of the students correctly at Writing Informational Domain. The highest p-value is at the Writing Prompt-Narrative Domain which is $72 \%$. The total p-value by domains is $58 \%$

Although the percentage of students responding correctly for the first four domains similar, there are approximately $1 / 3$ as many items in the Reading at Word Level (8) than the Reading Informational Text (21) and Reading Literature (24) Domains, and the Writing Informational and Writing Prompt-Narrative have $1 / 2$ as many items (4) as the Reading Domains.

## Grade 5 ELA (p-value and domain) - All Items

| Domain | p-value | N |
| :--- | :---: | ---: |
| Reading at Word Level | .565000 | 8 |
| Reading Informational Text | .545714 | 21 |
| Reading Literature | .579167 | 24 |
| Writing Informational | .615000 | 4 |
| Writing Prompt-Narrative | .725000 | 4 |
| Total | .577705 | 61 |

Table 27. Grade 5 ELA (p-value and domain) - All Items


Figure 18. Grade 5 ELA (p-value and domain) - All Items

## Item Difficulty by Domain and Tier

We examined grade 5 ELA p-value of domain by tier to determine the percent of students who responded correctly for each domain at each tier level. A total of 61 items were analyzed to determine the $p$-values for each of the domains by tiers.

The total p-value for the domains in Tier 1 is higher than any other tier with a total p-value of $77 \%$. The p-values for the domains at other tiers are $53 \%$ for the domains in Tier $2,52 \%$ for the domains in Tier 3, and $49 \%$ for the domains in Tier 4, and a total p-value of $58 \%$ for all domains and all tiers. The number of students responding correctly for the domains in each tier is similar to the p-values in grades 3 and 4 . It is important to note the following:

- there are no items at the Foundational-Reading at the Word Level Domain
- there is only 1 item in Tiers 2 and 4 for the Reading at the Word Level Domain, with 2 items in Tier 1 and 4 items in Tier 3
- there are 0 items for the Reading Informational Domain in Tier 4 and 3 items for this domain in Tier 1, with Tiers 2 and 3 containing more than twice as many items, 10 and 8 , respectively
- there are 0 items for the Reading Literature Domain in Tier 2 (this is similar to grades 3 and 4), with 14 items in Tier 3 and half the number in Tier 4 (6) and 4 items in Tier 1
- there is only 1 item in each of the 4 tiers for the Writing Informational Domain, also similar to grades 3 and 4
- all 4 items in the Writing Prompt Narrative Domain are found in Tier 1, also similar to grades 3 and 4

Based on the above data, there is a broad range of the number of items in the different domains at each tier and across tiers. For example, there are 3 items in the Reading Informational Text Domain at Tier 1, 10 and 8 items of the same domain in Tiers 2 and 3, and 0 at Tier 4.

|  | F-RWL | RWL | RI | RL | WI | WP-N |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 0 | 2 | 3 | 4 | 1 | 4 |
| Tier 2 | 0 | 1 | 10 | 0 | 1 | 0 |
| Tier 3 | 0 | 4 | 8 | 14 | 1 | 0 |
| Tier 4 | 0 | 1 | 0 | 6 | 1 | 0 |

## Grade 5 ELA ( $p$-value of domain by tier) - All Items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Reading at Word Level | . 695000 | 2 |
|  | Reading Informational Text | . 810000 | 3 |
|  | Reading Literature | . 800000 | 4 |
|  | Writing Informational | . 840000 | 1 |
|  | Writing Prompt-Narrative | . 725000 | 4 |
|  | Total | . 768571 | 14 |
| Tier 2 | Reading at Word Level | . 510000 | 1 |
|  | Reading Informational Text | . 515000 | 10 |
|  | Writing Informational | . 720000 | 1 |
|  | Total | . 531667 | 12 |
| Tier 3 | Reading at Word Level | . 567500 | 4 |
|  | Reading Informational Text | . 485000 | 8 |
|  | Reading Literature | . 540714 | 14 |
|  | Writing Informational | . 440000 | 1 |
|  | Total | . 524444 | 27 |
| Tier 4 | Reading at Word Level | . 350000 | 1 |
|  | Reading Literature | . 521667 | 6 |
|  | Writing Informational | . 460000 | 1 |
|  | Total | . 492500 | 8 |
| Total | Reading at Word Level | . 565000 | 8 |
|  | Reading Informational Text | . 545714 | 21 |
|  | Reading Literature | . 579167 | 24 |
|  | Writing Informational | . 615000 | 4 |
|  | Writing Prompt-Narrative | . 725000 | 4 |
|  | Total | . 577705 | 61 |

Table 29. Grade 5 ELA (p-value of domain by tier) - All Items

## Grade 5 ELA (p-value of domain by tier) - All Items



Figure 19. Grade 5 ELA Heat Map of P-Value by Domain and Tier

## Distribution of Items

An analysis of the 61 items in grade 5 ELA shows a good spread of items across all deciles with slightly fewer in deciles 9 and 10 and a spike in decile 5. With the LOSS included, there are no items in decile one. However, adjusting to exclude these scores reveals a spread of items across deciles 1 through 7, with fewer items in deciles 9-10.

Grade 5 ELA Items by Decile

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 0 | 0 |
| 2 | 4 | 6.6 |
| 3 | 9 | 14.8 |
| 4 | 8 | 13.1 |
| 5 | 6 | 9.8 |
| 6 | 14 | 23.0 |
| 7 | 7 | 11.5 |
| 8 | 6 | 9.8 |
| 9 | 4 | 6.6 |
| 10 | 3 | 4.9 |
| Total | 61 | 100.0 |

Table 30. Grade 5 ELA Items by Decile


Figure 20. Grade 5 ELA Items by Decile

Grade 5 ELA Items by Decile LOSS Excluded

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 7 | 11.47 |
| 2 | 6 | 9.8 |
| 3 | 7 | 11.5 |
| 4 | 5 | 8.2 |
| 5 | 12 | 19.7 |
| 6 | 5 | 8.2 |
| 7 | 9 | 14.8 |
| 8 | 5 | 8.2 |
| 9 | 2 | 3.3 |
| 10 | 3 | 4.9 |
| Total | 61 | 100.0 |

Table 31. Grade 5 ELA Items by Decile LOSS Excluded.


Figure 21. Grade 5 ELA Items by Decile LOSS Excluded.

## Grade 6 ELA

Item Difficulty by Tier
We examined grade 6 ELA tier and p-values to determine the percent of students who responded correctly at each level of complexity. Tier 1 items are intended to provide the highest level of support, while Tier 4 items provide the least amount of support and are therefore similar to grade level accomplishment. A total
of 74 items were analyzed, all of which are MC items, to determine the p-values at each tier. Similar to grade 5, there are no CR items in grade 6.

The p-values vary at all tiers, with p-values at $78 \%$ for Tier 1, $62 \%$ at Tier $2,54 \%$ at Tier 3, and $44 \%$ at Tier 4. Tier 1 , which provides the highest level of support, has the highest percentage of students responding correctly. Tier 1 has a total number of 23 items, Tier 2 has a total number of 19 items, Tier 3 has a total number of 25 items, and Tier 4 has a total number of 7 items. The total p -value for the 74 items is $63 \%$

It is important to note that Tier 4 has approximately $1 / 3$ as many items as Tiers 1,2 , and 3.

## Grade 6 ELA (p-value and

 tier) All Items| Tier | p-value | N |
| :--- | :---: | ---: |
| Tier 1 | .779130 | 23 |
| Tier 2 | .625789 | 19 |
| Tier 3 | .539200 | 25 |
| Tier 4 | .441429 | 7 |
| Total | .626757 | 74 |

Table 32. Grade 6 ELA (p-value and tier) All Items

Grade 6 ELA (p-value and tier) - All items


Figure 22. Grade 6 ELA (p-value and tier) All Items

## Item Difficulty by Domain

We examined Grade 6 ELA domains and p-values to determine the percent of students who responded correctly for each domain. A total of 74 items were analyzed to determine the p -values for each of the five domains, which include:

- Reading at Word Level (11 items)
- Reading Informational Text (29 items)
- Reading Literature (25 items)
- Writing Literary (4 items)
- Writing Prompt-Expository (5 items)

There are no items at the Foundational-Reading at the Word Level Domain for grade 6. It is important to note that the names of two of the domains changed from previous grades in grade 6 and it is unclear if the items focused on the same concepts. Specifically, one grade 6 domain is titled Writing Literary, whereas previous grades had a domain titled Writing Prompt-Narrative, and another grade 6 domain is titled Writing Prompt-Expository, whereas previous grades had a domain titled Writing Informational.

The p-value for all domains were similar, with $69 \%$ of the students responding correctly at the Reading at Word Level Domain, $63 \%$ of the students responding correctly at Reading Informational Text Domain, $59 \%$ of students responding correctly at Reading Literature Text Domain, $57 \%$ of students responding correctly at Writing Literary Domain, and $66 \%$ of the students responding correctly at Writing PromptExpository Domain. The highest p-value is at the Reading at Word Level Domain and the total p-value by domains is $63 \%$. The overall $p$-value for all domains is $63 \%$.

Although the percentage of students responding correctly for the five domains are similar, there are approximately $1 / 2$ as many items in the Reading at Word Level (11) than the Reading Informational Text (29) and Reading Literature (25) Domains, and the Writing Literary and Writing Prompt-Expository Domains have less than $1 / 5$ as many items ( 4,5 respectively) as the Reading Domains.

## Grade 6 ELA (p-value and domain) - All Items

| Domain | p-value | N |
| :--- | :---: | ---: |
| Reading at Word Level | .694545 | 11 |
| Reading Informational Text | .631379 | 29 |
| Reading Literature | .592800 | 25 |
| Writing Literary | .575000 | 4 |
| Writing Prompt-Expository | .662000 | 5 |
| Total | .626757 | 74 |

Table 33. Grade 6 ELA (p-value and domain) - All Items


Figure 23. Grade 6 ELA (p-value and domain) - All Items

## Item Difficulty by Domain and Tier

We examined Grade 6 ELA p-value of domain by tier to determine the percent of students who responded correctly for each domain at each tier level. A total of 74 items were analyzed to determine the p -values for each of the domains by tiers.

The total $p$-value for the domains in Tier 1 is higher than any other tier with a total $p$-value of $78 \%$. The p-values for the domains at other tiers are $62 \%$ for the domains in Tier 2, $54 \%$ for the domains in Tier 3, and $44 \%$ for the domains in Tier 4, and a total p-value of $63 \%$ for all domains and all tiers. It is important to note the following:

- there are no items at the Foundational-Reading at the Word Level Domain
- there is only 1 item in Tier 4 for the Reading at the Word Level Domain, with 3 items in Tiers 1 and 2, and 4 items in Tier 3
- there are 0 items for the Reading Informational Domain in Tier 2; whereas there are 14 items for this domain in Tier 1, 10 items in Tier 3 and $1 / 2$ as many items in Tier 4 (5)
- there are 0 items for the Reading Literature Domain in Tier 1 and Tier 4, with 15 items in Tier 2 and 10 items in Tier 3
- there is only 1 item in each of the 4 tiers for the Writing Literary Domain
- all 5 items in the Writing Prompt Expository Domain are found in Tier 1

Based on the above data, there is a broad range of the number of items in the different domains at each tier and across tiers. For example, there are 0 items in the Reading Literary Domain at Tiers 1 and 4, with 15 and 10 items of the same domain in Tiers 2 and 3, respectively.

|  | F-RWL | RWL | RI | RL | WL | WP-E |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 0 | 3 | 14 | 0 | 1 | 5 |
| Tier 2 | 0 | 3 | 0 | 15 | 1 | 0 |
| Tier 3 | 0 | 4 | 10 | 10 | 1 | 0 |
| Tier 4 | 0 | 1 | 5 | 0 | 1 | 0 |

Table 34. Grade 6 ELA Items by Domain and Tier

## Grade 6 ELA (p-value of domain by tier) All Items

| Tier | Domain | p-value | N |
| :--- | :--- | ---: | ---: |
| Tier 1 | Reading at Word Level | .786667 | 3 |
|  | Reading Informational Text | .826429 | 14 |
|  | Writing Literary | .680000 | 1 |
|  | Writing Prompt-Expository | .662000 | 5 |
|  | Total | .779130 | 23 |
| Tier 2 | Reading at Word Level | .746667 | 3 |
|  | Reading Literature | .612667 | 15 |
|  | Writing Literary | .460000 | 1 |
|  | Total | .625789 | 19 |
| Tier 3 | Reading at Word Level | .615000 | 4 |
|  | Reading Informational Text | .473000 | 10 |
|  | Reading Literature | .563000 | 10 |
|  | Writing Literary | .66000 | 1 |
|  | Total | .539200 | 25 |
| Tier 4 | Reading at Word Level | .580000 | 1 |
|  | Reading Informational Text | .402000 | 5 |
|  | Writing Literary | .500000 | 1 |
|  |  | Total | .441429 |

Table 35. Grade 6 ELA (p-value of domain by tier) - All Items

## Grade 6 ELA (p-value of domain by tier) - All Items



Figure 24. Grade 6 ELA Heat Map of P-Value by Tier and Domain

## Distribution of Items

An analysis of the 74 items in grade 6 ELA shows a good spread of items in the lowest deciles, except as expected in decile 1 with the LOSS included. Removing the LOSS, we observe the bulk of the items in deciles 1-5 with a slight reduction in deciles 6-10.

Grade 6 ELA Items by Decile

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 0 | 0 |
| 2 | 12 | 16.2 |
| 3 | 9 | 12.2 |
| 4 | 13 | 17.6 |
| 5 | 11 | 14.9 |
| 6 | 14 | 18.9 |
| 7 | 3 | 4.1 |
| 8 | 4 | 5.4 |
| 9 | 3 | 4.1 |
| 10 | 5 | 6.8 |
| Total | 74 | 100.0 |

Table 36. Grade 6 ELA Items by Decile


Figure 25. Grade 6 ELA Items by Decile.

Grade 6 ELA Items by Decile LOSS Excluded

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 13 | 17.5 |
| 2 | 8 | 10.8 |
| 3 | 12 | 16.2 |
| 4 | 10 | 13.5 |
| 5 | 12 | 16.2 |
| 6 | 6 | 8.1 |
| 7 | 2 | 2.7 |
| 8 | 5 | 6.8 |
| 9 | 2 | 2.7 |
| 10 | 4 | 5.4 |
| Total | 74 | 100.0 |

Table 37. Grade 6 ELA Items by Decile LOSS Excluded.

## Number of Items by Ability Decile Grade 6 ELA (LOSS Excluded)



Figure 26. Grade 6 ELA Items by Decile LOSS Excluded.

## Grade 7 ELA

## Item Difficulty by Tier

We examined grade7 ELA tier and p-values to determine the percent of students who responded correctly at each level of complexity. Tier 1 items are intended to provide the highest level of support while Tier 4 items provide the least amount of support and are therefore similar to grade level accomplishment. A total
of 80 items were analyzed, all of which are MC items, to determine the p-values at each tier. Similar to grade 5 and 6 , there are no $\mathbf{C R}$ items in grade 7.

The p-values vary at each tier, although Tiers 3 and 4 are similar, with p-values at $52 \%$ for Tier 3 and $50 \%$ at Tier 4 . Tier 1, which provides the highest level of support, has the highest percentage of students who scored correctly with a p-value at $76 \%$ and Tier 2 has a p-value at $61 \%$. Tier 1 has a total number of 25 items, Tier 2 has a total number of 18 items, Tier 3 has a total number of 28 items, and Tier 4 has a total number of 9 items. The total p-value for the 80 items is $61 \%$.

It is important to note that Tier 4 has approximately $1 / 3$ as many items as Tiers 1 and 3 , and $1 / 2$ as many items as Tier 2.

Grade 7 ELA (p-value and
tier) - All Items

| Tier | p-value | N |
| :--- | :---: | ---: |
| Tier 1 | .755600 | 25 |
| Tier 2 | .615000 | 18 |
| Tier 3 | .518929 | 28 |
| Tier 4 | .498889 | 9 |
| Total | .612250 | 80 |

Table 38. Grade 7 ELA (p-value and tier) - All Items


Figure 27. Grade 7 ELA (p-value and tier) - All Items

## Item Difficulty by Domain

We examined grade 7 ELA domains and p-values to determine the percent of students who responded correctly for each domain. A total of 80 items were analyzed to determine the p-values for each of the five domains, which include:

- Reading at Word Level (11 items)
- Reading Informational Text (35 items)
- Reading Literature (24 items)
- Writing Literary (4 items)
- Writing Prompt-Expository (6 items)

There are no items at the Foundational-Reading at the Word Level Domain for grade 7.
It is important to note that the names of two of the domains changed from grades $3-5$ beginning in grade 6 and it is unclear if the items focused on the same concepts. Specifically, one grade 7 domain is titled Writing Literary, whereas previous grades had a domain titled Writing Prompt-Narrative, and another grade 7 domain is titled Writing Prompt-Expository, whereas previous grades had a domain titled Writing Informational.

The p-value for 4 of the 5 domains were similar, with $61 \%$ of the students responding correctly at the Reading at Word Level Domain, $61 \%$ of the students responding correctly at Reading Informational Text Domain, $61 \%$ of students responding correctly at Reading Literature Domain, and $59 \%$ of the students responding correctly at the Writing Literary Domain. The Writing Prompt-Expository Domain had the highest p-value at $67 \%$. The overall p-value for all domains is $61 \%$.

Although the percentage of students responding correctly for the domains are similar, there are approximately $1 / 2$ as many items in the Reading at Word Level (11) than the Reading Informational Text (35) and Reading Literature (24) Domains, and the Writing Literary and Writing Prompt-Expository Domains have less than $1 / 4$ as many items ( 4,6 respectively) as the Reading Domains.

## Grade 7 ELA (p-value and domain) All Items

| Domain | p-value | N |
| :--- | :---: | ---: |
| Reading at Word Level | .609091 | 11 |
| Reading Informational Text | .608857 | 35 |
| Reading Literature | .607083 | 24 |
| Writing Literary | .587500 | 4 |
| Writing Prompt-Expository | .675000 | 6 |
| Total | .612250 | 80 |

Table 39. Grade 7 ELA (p-value and domain) -


Figure 28. Grade 7 ELA (p-value and domain) - All Items

## Item Difficulty by Domain and Tier

We examined grade 7 ELA p-value of domain by tier to determine the percent of students who responded correctly for each domain at each tier level. A total of 80 items were analyzed to determine the $p$-values for each of the domains by tiers.

The total p -value for the domains in Tier 1 is higher than any other tier with a total p -value of $76 \%$. The p-values for the domains at other tiers are $61 \%$ for the domains in Tier 2, $52 \%$ for the domains in Tier 3, and $50 \%$ for the domains in Tier 4, and a total p-value of $61 \%$ for all domains and all tiers. It is important to note the following:

- There are no items at the Foundational-Reading at the Word Level Domain
- There is only 1 item in Tier 4 for the Reading at the Word Level Domain, with 3 items in Tiers 1 and 2, and 4 items in Tier 3
- there are 0 items for the Reading Informational Domain in Tier 2; whereas there are 15 items for this domain in Tier 1, 13 items in Tier 3 and $1 / 2$ as many items in Tier 4 (7)
- there are 0 items for the Reading Literature Domain in Tier 1 and Tier 4, with 14 items in Tier 2 and 10 items in Tier 3
- there is only 1 item in each of the 4 tiers for the Writing Literary Domain
- all 6 items in the Writing Prompt Expository Domain are found in Tier 1

The number of items for each of the domains in grade 7 is similar to the number of items for each domain in grade 6 . Based on the above data, there is a broad range of the number of items in the different domains
at each tier and across tiers. For example, there are 0 items in the Reading Literary Domain at Tiers 1 and 4 with 14 and 10 items of the same domain in Tiers 2 and 3, respectively.

|  | F-RWL | RWL | RI | RL | WL | WP-E |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 0 | 3 | 15 | 0 | 1 | 6 |
| Tier 2 | 0 | 3 | 0 | 14 | 1 | 0 |
| Tier 3 | 0 | 4 | 13 | 10 | 1 | 0 |
| Tier 4 | 0 | 1 | 7 | 0 | 1 | 0 |

Table 40 Grade 7 ELA Items by Domain and Tier

## Grade 7 ELA (p-value of domain by tier) All Items

| Tier | Domain | p-value | N |
| :--- | :--- | :--- | ---: |
| Tier 1 | Reading at Word Level | .746667 | 3 |
|  | Reading Informational Text | .784000 | 15 |
|  | Writing Literary | .840000 | 1 |
|  | Writing Prompt-Expository | .675000 | 6 |
|  | Total | .755600 | 25 |
| Tier 2 | Reading at Word Level | .590000 | 3 |
|  | Reading Literature | .620000 | 14 |
|  | Writing Literary | .620000 | 1 |
|  | Total | .615000 | 18 |
| Tier 3 | Reading at Word Level | .545000 | 4 |
|  | Reading Informational Text | .470000 | 13 |
|  | Reading Literature | .589000 | 10 |
|  | Writing Literary | .350000 | 1 |
|  | Total | .518929 | 28 |
| Tier 4 | Reading at Word Level | .510000 | 1 |
|  | Reading Informational Text | .491429 | 7 |
|  | Writing Literary | .540000 | 1 |
|  |  | .498889 | 9 |
| Total | Reading at Word Level | .609091 | 11 |
|  | Reading Informational Text | .608857 | 35 |
|  | Reading Literature | .607083 | 24 |
|  | Writing Literary | .587500 | 4 |
|  | Writing Prompt-Expository | .675000 | 6 |
|  | Total | .612250 | 80 |

Table 41. Grade 7 ELA (p-value of domain by tier) -All Items

## Grade 7 ELA (p-value of domain by tier) - All Items



Figure 29. Grade 7 ELA Heat Map of P-Value by Domain and Tier

## Distribution of Items

An analysis of the 80 items in grade 7 ELA shows a good spread of items across all but the highest deciles. With the LOSS included, there are no items in decile one. However, adjusting to exclude these scores reveals a spread of items across deciles 1 through 7, with fewer items in deciles 8-10.

Grade 7 ELA Items by Decile

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 0 | 0 |
| 2 | 7 | 8.8 |
| 3 | 14 | 17.5 |
| 4 | 14 | 17.5 |
| 5 | 10 | 12.5 |
| 6 | 16 | 20.0 |
| 7 | 10 | 12.5 |
| 8 | 3 | 3.8 |
| 9 | 5 | 6.3 |
| 10 | 1 | 1.3 |
| Total | 80 | 100.0 |

Table 42. Grade 7 ELA Items by Decile


Figure 30. Grade 7 ELA Items by Decile

Grade 7 ELA Items by Decile LOSS Excluded

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 7 | 8.75 |
| 2 | 14 | 17.5 |
| 3 | 7 | 8.8 |
| 4 | 15 | 18.8 |
| 5 | 10 | 12.5 |
| 6 | 14 | 17.5 |
| 7 | 5 | 6.3 |
| 8 | 3 | 3.8 |
| 9 | 4 | 5.0 |
| 10 | 1 | 1.3 |
| Total | 80 | 100.0 |



Figure 31. Grade 7 ELA Items by Decile LOSS Excluded.

## Grade 8 ELA

## Item Difficulty by Tier

We examined grade 8 ELA tier and p-values to determine the percent of students who responded correctly at each level of complexity. Tier 1 items are intended to provide the highest level of support while Tier 4 items provide the least amount of support and are therefore similar to grade level accomplishment. A total
of 85 items were analyzed, all of which are MC items, to determine the p-values at each tier. Similar to grade 5-7, there are no CR items in grade 8 .

The p-values vary at each tier with p-values at $76 \%$ for Tier 1, $62 \%$ for Tier 2, $53 \%$ for Tier 3, and $45 \%$ for Tier 4. Tier 1provides the highest level of support so it is not surprising that percentage of students responding correctly is in this tier. Tier 1 has a total number of 23 items, Tier 2 has a total number of 23 items, Tier 3 has a total number of 28 items, and Tier 4 has a total number of 11 items. The total p-value for the 85 items is $61 \%$.

It is important to note that Tier 4 has approximately $1 / 2$ as many items as the other tiers.

## Grade 8 ELA (p-value and

tier) - All Items

| Tier | p-value | N |
| :--- | :--- | :--- |
| Tier 1 | .756522 | 23 |
| Tier 2 | .624783 | 23 |
| Tier 3 | .529643 | 28 |
| Tier 4 | .450909 | 11 |
| Total | .606588 | 85 |

Table 44. Grade 8 ELA (p-value and tier) - All Items


Figure 32. Grade 8 ELA (p-value and tier) - All Items

Grade 8 ELA domains and p-values were examined to determine the percent of students who responded correctly for each domain. A total of 85 items were analyzed to determine the p-values for each of the five domains, which include:

- Reading at Word Level (11 items)
- Reading Informational Text (41 items)
- Reading Literature (23 items)
- Writing Prompt-Expository (6 items)
- Writing Prompt-Persuasive (4 items)

There are no items at the Foundational-Reading at the Word Level Domain for grade 8.
It is important to note that the names of one of the domains changed from grades 3-5 beginning in grade 6 and it is unclear if the items focused on the same concepts. Specifically, the domain titled Writing Informational (grades 3-5) changed to Writing Prompt-Expository (grades 6-8). In addition, the Writing Literary Domain has been replaced with the Writing Prompt-Persuasive Domain.

The p-value for the 5 domains vary with $61 \%$ of the students responding correctly at the Reading at Word Level Domain, $56 \%$ of the students responding correctly at Reading Informational Text Domain, $64 \%$ of students responding correctly at Reading Literature Domain, $73 \%$ of the students responding correctly at the Writing Prompt-Expository Domain, and $64 \%$ of the students responding correctly at the Writing Prompt Persuasive Domain. The Writing Prompt-Expository Domain had the highest p-value, similar to grade 7. The overall p-value for all domains is $61 \%$.

It is important to note that there are significantly more items for the Reading Informational Text Domain, with approximately $1 / 2$ as many items in the Reading Literature Domain (23), $1 / 4$ as many items in the Reading at Word Level (11) than the Reading Informational Text Domain, and the Writing PromptExpository and Writing Prompt-Persuasive Domains have less than $1 / 10$ as many items ( 4,6 respectively) as the Reading Informational Text Domain.

## Grade 8 ELA (p-value and domain) All Items

| Domain | p-value | N |
| :--- | :---: | ---: |
| Reading at Word Level | .611818 | 11 |
| Reading Informational Text | .564390 | 41 |
| Reading Literature | .641739 | 23 |
| Writing Prompt-Expository | .726667 | 6 |
| Writing Prompt-Persuasive | .642500 | 4 |
| Total | .606588 | 85 |

Table 45. Grade 8 ELA ( $p$-value and domain) -


Figure 33. Grade 8 ELA (p-value and domain) -All Items

## Item Difficulty by Domain and Tier

We examined grade 8 ELA p-value of domain by tier to determine the percent of students who responded correctly for each domain at each tier level. A total of 85 items were analyzed to determine the p -values for each of the domains by tiers.

The total p -value for the domains in Tier 1 is higher than any other tier with a total p-value of $76 \%$. The $p$-values for the domains at other tiers are $62 \%$ for the domains in Tier 2, $53 \%$ for the domains in Tier 3, and $45 \%$ for the domains in Tier 4, and a total p-value of $61 \%$ for all domains and all tiers. It is important to note the following:

- there are no items at the Foundational-Reading at the Word Level Domain
- there is only 1 item in Tier 4 for the Reading at the Word Level Domain, with 3 items in Tiers 1 and 2 , and 4 items in Tier 3
- there are a similar number of items for the Reading Informational Domain across tiers
- there are 0 items for the Reading Literature Domain in Tier 1, 3 items in Tier 1, and 3 times as many items in Tiers 2 and 3 (10)
- all 6 items in the Writing Prompt Expository Domain are found in Tier 1
- there is only 1 item in each of the 4 tiers for the Writing Prompt-Persuasive Domain

Based on the above data, there is a broad range of the number of items in the same domains at each tier and across tiers. For example, there are 0 items in the Reading Literary Domain at Tier 4 with 3 items at Tier 1 and 10 items of the same domain in Tiers 2 and 3.

|  | F-RWL | RWL | RI | RL | WP-E | WP-P |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 0 | 3 | 10 | 3 | 6 | 1 |
| Tier 2 | 0 | 3 | 9 | 10 | 0 | 1 |
| Tier 3 | 0 | 4 | 13 | 10 | 0 | 1 |
| Tier 4 | 0 | 1 | 9 | 0 | 0 | 1 |

Table 46. Grade 8 ELA Items by Domain and Tier
Grade 8 ELA (p-value of domain by tier) All Items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Reading at Word Level | . 786667 | 3 |
|  | Reading Informational Text | . 719000 | 10 |
|  | Reading Literature | . 870000 | 3 |
|  | Writing Prompt-Expository | . 726667 | 6 |
|  | Writing Prompt-Persuasive | . 880000 | 1 |
|  | Total | . 756522 | 23 |
| Tier 2 | Reading at Word Level | . 630000 | 3 |
|  | Reading Informational Text | . 567778 | 9 |
|  | Reading Literature | . 682000 | 10 |
|  | Writing Prompt-Persuasive | . 550000 | 1 |
|  | Total | . 624783 | 23 |
| Tier 3 | Reading at Word Level | . 527500 | 4 |
|  | Reading Informational Text | . 515385 | 13 |
|  | Reading Literature | . 533000 | 10 |
|  | Writing Prompt-Persuasive | . 690000 | 1 |
|  | Total | . 529643 | 28 |
| Tier 4 | Reading at Word Level | . 370000 | 1 |
|  | Reading Informational Text | . 460000 | 9 |
|  | Writing Prompt-Persuasive | . 450000 | 1 |
|  | Total | . 450909 | 11 |
| Total | Reading at Word Level | . 611818 | 11 |
|  | Reading Informational Text | . 564390 | 41 |
|  | Reading Literature | . 641739 | 23 |
|  | Writing Prompt-Expository | . 726667 | 6 |
|  | Writing Prompt-Persuasive | . 642500 | 4 |
|  | Total | . 606588 | 85 |

Table 47. Grade 8 ELA (p-value of domain by tier) -All Items

## Grade 8 ELA (p-value of domain by tier) - All Items



Figure 34. Grade 8 ELA Heat Map of P-Values by Domain and Tier

## Items by Decile

An analysis of the 85 items in grade 8 ELA shows a good spread of items across all but the highest deciles. With the LOSS included, there are no items in decile one. However, adjusting to exclude the LOSS, items are spread across deciles 1 through 7, with a decline in deciles 8-10.

Grade 8 ELA Items by Decile

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 0 | 0 |
| 2 | 14 | 16.5 |
| 3 | 11 | 12.9 |
| 4 | 8 | 9.4 |
| 5 | 16 | 18.8 |
| 6 | 14 | 16.5 |
| 7 | 12 | 14.1 |
| 8 | 7 | 8.2 |
| 9 | 2 | 2.4 |
| 10 | 1 | 1.2 |
| Total | 85 | 100.0 |

Table 48. Grade 8 ELA Items by Decile


Figure 35. Grade 8 ELA Items by Decile

Grade 8 ELA Items by Decile LOSS Excluded

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 14 | 16.47059 |
| 2 | 11 | 12.9 |
| 3 | 8 | 9.4 |
| 4 | 15 | 17.6 |
| 5 | 10 | 11.8 |
| 6 | 10 | 11.8 |
| 7 | 10 | 11.8 |
| 8 | 4 | 4.7 |
| 9 | 2 | 2.4 |
| 10 | 1 | 1.2 |
| Total | 85 | 100.0 |

Table 49. Grade 8 ELA Items by Decile LOSS Excluded
Number of Items by Ability Decile Grade 8 ELA (LOSS Excluded)


Figure 36. Grade 8 ELA Items by Decile LOSS Excluded

## Grade 11 ELA

## Item Difficulty by Tier

We examined grade 11 ELA tier and p-values to determine the percent of students who responded correctly at each level of complexity. Tier 1 items are intended to provide the highest level of support while Tier 4 items provide the least amount of support and are therefore similar to grade level accomplishment. A total of 55 items were analyzed, all of which are MC items, to determine the p-values at each tier. Similar to grade 5-8, there are no CR items in grade 11.

The p-values vary at each tier with p-values at $79 \%$ for Tier 1, $66 \%$ for Tier 2,53\% for Tier 3, and $51 \%$ for Tier 4. Tier 1provides the highest level of support so it is not surprising that the highest percentage of items scored correctly is in this tier. Tier 1 has a total number of 19 items, Tier 2 has a total number of 11 items, Tier 3 has a total number of 16 items, and Tier 4 has a total number of 9 items. The total p-value for the 55 items is $64 \%$.

It is important to note that Tier 4 has approximately $1 / 2$ as many items as Tiers 1 and 3 .

## Grade 11 ELA (p-value and tier) - All Items

| Tier | p-value | N |
| :--- | :---: | ---: |
| Tier 1 | .785789 | 19 |
| Tier 2 | .663636 | 11 |
| Tier 3 | .535625 | 16 |
| Tier 4 | .506667 | 9 |
| Total | .642909 | 55 |

Table 50. Grade 11 ELA (p-value and tier) - All Items


Figure 37. Grade 11 ELA (p-value and tier) - All Items

## Item Difficulty by Domain

We examined grade 11 ELA domains and p-values to determine the percent of students who responded correctly for each domain. A total of 55 items were analyzed to determine the p-values for each of the five domains, which include:

- Reading at Word Level (8 items)
- Reading Informational Text (19 items)
- Reading Literature (19 items)
- Writing Informational (3 items)
- Writing Prompt-Argument (6 items)

There are no items at the Foundational-Reading at the Word Level Domain for grade 11.
It is important to note that the names of one of the domains changed. The Writing Informational Domain was found in grades 3-5, in grades 6-8 the domain was titled Writing Prompt-Expository, and in grade 11, the domain is Writing Informational (same as grades 3-5). It is unclear if the items focus on the same concepts for these domains. In addition, the Writing Literary Domain was replaced with the Writing Prompt-Persuasive Domain in grade 8, and is replaced with Writing Prompt-Argument for grade 11.

The p-value for 4 of the 5 domains are similar with $68 \%$ of the students responding correctly at the Reading at Word Level Domain, 59\% of the students responding correctly at Reading Informational Text Domain, $64 \%$ of students responding correctly at Reading Literature Domain, and $63 \%$ of the students responding correctly at the Writing Informational Domain. The Writing Prompt-Argument Domain had the highest p-value at $75 \%$. The overall p-value for all domains is $64 \%$.

It is important to note that there are significantly more items for the Reading Informational Text and Reading Literature Domains (19 each), with approximately $1 / 2$ as many items in the Reading at Word Level Domain (8), the Writing Informational Domain has $1 / 6$ as many items as the Reading Informational Text Domain, and the Writing Prompt-Argument Domain has less than $1 / 3$ as many items (6) as the Reading Informational Text Domain.

## Grade 11 ELA (p-value and domain) - <br> All Items

| Domain | p-value | N |
| :--- | :---: | ---: |
| Reading at Word Level | .683750 | 8 |
| Reading Informational Text | .593684 | 19 |
| Reading Literature | .641579 | 19 |
| Writing Informational | .633333 | 3 |
| Writing Prompt-Argument | .753333 | 6 |
| Total | .642909 | 55 |

Table 51. Grade 11 ELA (p-value and domain) - All Items

Grade 11 ELA ( $p$-value and domain) - All items


## Domain

Figure 38. Grade 11 ELA (p-value and domain) - All Items

## Item Difficulty by Domain and Tier

We examined grade 11 ELA p-value of domain by tier to determine the percent of students who responded correctly for each domain at each tier level. A total of 55 items were analyzed to determine the p -values for each of the domains by tiers.

The total p -value for the domains in Tier 1 is higher than any other tier with a total p -value of $78 \%$. The p-values for the domains at other tiers are $66 \%$ for the domains in Tier $2,53 \%$ for the domains in Tier 3, and $51 \%$ for the domains in Tier 4, and a total p-value of $64 \%$ for all domains and all tiers. It is important to note the following:

- there are no items at the Foundational-Reading at the Word Level Domain
- there is only 1 item in Tier 4 for the Reading at the Word Level Domain, with 3 items in Tier 3 and 2 items in Tiers 1 and 2
- there are 0 items in Tier 2 for Reading Informational Text, with 5 items in Tier 3 and 7 items in Tiers 1 and 4
- there are 0 items for the Reading Literature Domain in Tier 4, 3 items in Tier 1, and over 2 times as many items in Tiers 2 and 3 (8)
- there are 0 for the Writing Informational Domain in Tier 3, with 1 item in Tiers 1, 2, and 4
- all 6 items in the Writing Prompt-Argument Domain are found in Tier 1

Based on the above data, there is a broad range of the number of items in the same domains at each tier and across tiers. For example, there are 0 items in the Reading Literary Domain at Tier 4 with 3 items at Tier 1 and 8 items of the same domain in Tiers 2 and 3.

|  | F-RWL | RWL | RI | RL | WI | WP-A |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 0 | 2 | 7 | 3 | 1 | 6 |
| Tier 2 | 0 | 2 | 0 | 8 | 1 | 0 |
| Tier 3 | 0 | 3 | 5 | 8 | 0 | 0 |
| Tier 4 | 0 | 1 | 7 | 0 | 1 | 0 |

Grade 11 ELA (p-value of domain by tier) All Items

| Tier | Domain | Mean | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Reading at Word Level | . 815000 | 2 |
|  | Reading Informational Text | . 795714 | 7 |
|  | Reading Literature | . 836667 | 3 |
|  | Writing Informational | . 700000 | 1 |
|  | Writing Prompt-Argument | . 753333 | 6 |
|  | Total | . 785789 | 19 |
| Tier 2 | Reading at Word Level | . 710000 | 2 |
|  | Reading Literature | . 645000 | 8 |
|  | Writing Informational | . 720000 | 1 |
|  | Total | . 663636 | 11 |
| Tier 3 | Reading at Word Level | . 603333 | 3 |
|  | Reading Informational Text | . 448000 | 5 |
|  | Reading Literature | . 565000 | 8 |
|  | Total | . 535625 | 16 |
| Tier 4 | Reading at Word Level | . 610000 | 1 |
|  | Reading Informational Text | . 495714 | 7 |
|  | Writing Informational | . 480000 | 1 |
|  | Total | . 506667 | 9 |
| Total | Reading at Word Level | . 683750 | 8 |
|  | Reading Informational Text | . 593684 | 19 |
|  | Reading Literature | . 641579 | 19 |
|  | Writing Informational | . 633333 | 3 |
|  | Writing Prompt-Argument | . 753333 | 6 |
|  | Total | . 642909 | 55 |

Table 53 Grade 11 ELA (p-value of domain by tier) -All Items

## Grade 11 ELA (p-value of domain by tier) - All Items



Figure 39. Grade 11 ELA Heat Map of P-Value by Domain and Tier

## Items by Decile

55 items were analyzed in grade 11 ELA. With the LOSS included, there are no items in decile 1 or decile 9 and the bulk of the items are in deciles 2-7. When the LOSS is excluded, items are spread across deciles 1-6 and fewer items are found in deciles 7-10. This is similar to the pattern observed throughout all lower grades of ELA.

Grade 11 ELA Items by Decile

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 0 |  |
| 2 | 11 | 20.0 |
| 3 | 7 | 12.7 |
| 4 | 8 | 14.5 |
| 5 | 7 | 12.7 |
| 6 | 7 | 12.7 |
| 7 | 8 | 14.5 |
| 8 | 3 | 5.5 |
| 9 | 0 | 0.0 |
| 10 | 4 | 7.3 |
| Total | 55 | 100.0 |

Table 54. Grade 11 ELA Items by Decile


Figure 40. Grade 11 ELA Items by Decile

Grade 11 ELA Items by Decile LOSS Excluded

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 7 | 12.7 |
| 2 | 10 | 18.2 |
| 3 | 4 | 7.3 |
| 4 | 11 | 20.0 |
| 5 | 3 | 5.5 |
| 6 | 10 | 18.2 |
| 7 | 3 | 5.5 |
| 8 | 3 | 5.5 |
| 9 | 2 | 3.6 |
| 10 | 2 | 3.6 |
| Total | 55 | 100.0 |

Table 55. Grade 11 ELA Items by Decile LOSS Excluded


Figure 41. Grade 11 ELA Items by Decile LOSS Excluded.

## Grade 3 Math

## Item Difficulty by Tier

We examined grade 3 Math tier and $p$-values were to determine the percentage of students who responded correctly at each level of complexity. Tier 1 items are intended to provide the highest level of support while Tier 4 items provide the least amount of support and are therefore similar to grade level accomplishment. A total of 80 items, which represent a combination of 73 multiple choice and 7
constructed response items, were analyzed, both together and separately, to determine the p-values at each tier.

The p-values vary at all tiers, in which $68 \%$ of the students responded correctly at Tier $1,51 \%$ of the students responded correctly at Tier $2,47 \%$ of the students responded correctly at Tier 3 , and $40 \%$ of the students responded correctly at Tier 4 . The highest level of support is provided for Tier1 items; therefore, it is not surprising that all 16 items are multiple choice items (selected response) and have the highest percentage of students responding correctly. Tier 2 has a total of 30 items, Tier 3 has 24 items, and Tier 4 has 10 items, which is the least number of items. The total p-value for all 80 items combined is $52 \%$.

The p-value at Tiers 2 and 3 were similar, with $51 \%$ of the students responding correctly at Tier 2 and $46 \%$ of the students responding correctly at Tier 3. The p-value for Tier 1 was the highest with $68 \%$ of the students responding correctly. The p-value for Tier 4 was the lowest with $39 \%$ of the students responding correctly. As noted above, all 16 Tier 1 items are multiple choice. There are 26 items in Tier 2, 22 items in Tier 3, and 9 items in Tier 4. In addition to the similarity of the percentage of students responding correctly for Tiers 2 and 3, there are also a similar number of items in these tiers; by contrast, Tier 4 has approximately $1 / 3$ the number of items as Tiers 2 and 3 . The total p-value for the 73 MC items is $52 \%$.

No CR response items were identified at Tier 1 . The p-value at Tiers 2, 3, and 4 were similar, ranging from $50 \%$ to $54 \%$ of students responding correctly. The p-value for Tier 4 was lowest with $50 \%$ of the students responding correctly, $51 \%$ at Tier 3 , and the highest at Tier 2 with a p-value at $54 \%$. There are 4 items in Tier 2, 2 items in Tier 3, and 1 item in Tier 4, with a total of 7 CR items. The total p-value for these items is $52 \%$.

The nine (9) Tier 4 MC items have the lowest p-value at $39 \%$, whereas the one (1) Tier 4 CR item has a p-value of $50 \%$. The percentage of students who responded correctly at Tier 4 has the lowest p-value whether the items are $\mathrm{MC}, \mathrm{CR}$, or combined items. It is not surprising that these items have the lowest pvalue, as they have the least amount of complexity and support. The p-values for Tiers 2 and 3 are similar, whether the items are $\mathrm{MC}, \mathrm{CR}$, or combined items (Tier 2 All Items p-value $=51 \%, \mathrm{MC}$ Items p -value $=$ $51 \%$, CR Items p-value $=54 \%$; Tier 3 All Items p-value $=47 \%$, MC Items p-value $=46 \%, C R$ Items pvalue $=51 \%$ ) .

Grade 3 Math (p-value and tier) All Items

| Tier | p-value | $\mathbf{N}$ |
| :--- | ---: | :--- |
| Tier 1 | .684375 | 16 |
| Tier 2 | .513333 | 30 |
| Tier 3 | .468333 | 24 |
| Tier 4 | .405000 | 10 |
| Total | .520500 | 80 |

Table 56. Grade 3 Math (p-value and tier) All Items

Grade 3 Math ( $p$-value and tier) - All items


Figure 42. Grade 3 Math ( $p$-value and tier) All Items

Grade 3 Math ( $p$-value and tier) MC Items

| Tier | p-value | N |
| :--- | :---: | :---: |
| Tier 1 | .684375 | 16 |
| Tier 2 | .509615 | 26 |
| Tier 3 | .464545 | 22 |
| Tier 4 | .394444 | 9 |
| Total | .520137 | 73 |

[^2]

Figure 43. Grade 3 Math ( $p$-value and tier) MC Items

Grade 3 Math ( p -value and tier) CR Items

| Tier | p-value | $\mathbf{N}$ |
| :--- | :---: | :---: |
| Tier 2 | .537500 | 4 |
| Tier 3 | .510000 | 2 |
| Tier 4 | .500000 | 1 |
| Total | .524286 | 7 |

Table 58. Grade 3 Math (p-value and tier) CR Items


Figure 44. Grade 3 Math ( $p$-value and tier) CR Items

## Item Difficulty by Domain

We examined grade 3 Math domains and p-values to determine the percentage of students who responded correctly for each domain. A total of 80 items, which represent a combination of 73 multiple choice and 7 constructed response items, were analyzed, both together and separately, to determine the p-values for each of the five domains, which include:

- Geometry ( 10 items)
- Measurement and Data (16 items)
- Number and Operations Base Ten (15 items)
- Number and Operations Fractions ( 16 items)
- Operations and Algebraic Thinking (23 items)

The p-value for several domains was similar; however there was a range from $46 \%$ to $62 \%$ of students responding correctly to the items in the domains. The Geometry Domain had the highest p-value ( $62 \%$ ) and the Number and Operations Fractions had the lowest p-value (47\%). The Measurement and Data Domain had a p-value at $54 \%$, Number and Operations Base Ten Domain had a p-value at $51 \%$, and Operations and Algebraic Thinking had a p-value at $51 \%$. The total $p$-value for all 80 items is $52 \%$.

It is important to note that the Geometry Domain has $1 / 2$ as many items (10) as the Operations and Algebraic Thinking Domain ( 23 items). The other domains have an equal number of items, with 16 items in Measurement and Data Domain, 15 items in Number and Operations Base Ten Domain, and 16 items in Number and Operations Fractions Domain.

The only domain that contains constructed response items is the Measurement and Data Domain in which approximately $1 / 2$ of the 16 items are constructed response (7) and $1 / 2$ are multiple choice (9). The percentage of students responding correctly is similar with a p-value of $54 \%$ for the 9 multiple choice items is and a p-value of $52 \%$ for the 7 constructed response items.

Grade 3 Math (p-value and domain) - All Items

| Domain | p-value | N |
| :--- | :---: | :---: |
| Geometry | .617000 | 10 |
| Measurement and Data | .541875 | 16 |
| Number and Operations Base Ten | .511333 | 15 |
| Number and Operations Fractions | .466875 | 16 |
| Operations and Algebraic Thinking | .506957 | 23 |
| Total |  | .520500 |

Table 59. Grade 3 Math (p-value and domain) - All Items

Grade 3 Math (p-value and domain) - All Items


Figure 45. Grade 3 Math (p-value and domain) - All Items

Grade 3 Math ( $p$-value and domain) - MC Items

| Domain | p-value | N |
| :--- | :---: | :---: |
| Geometry | .617000 | 10 |
| Measurement and Data | .555556 | 9 |
| Number and Operations Base Ten | .511333 | 15 |
| Number and Operations Fractions | .466875 | 16 |
| Operations and Algebraic Thinking | .506957 | 23 |
| Total |  | .520137 |

Table 60. Grade 3 Math (p-value and domain) - MC Items


Figure 46. Grade 3 Math (p-value and domain) - MC Items

## Grade 3 Math (p-value and domain) - CR Items

| Domain | p-value | N |
| :--- | :---: | :---: |
| Measurement and Data | .524286 | 7 |
| Total | .524286 | 7 |

We examined grade 3 Math p-value of domain by tier to determine the percentage of students who responded correctly for each domain at each tier level. A total of 80 items, which represent a combination of 73 multiple choice and 7 constructed response items, were analyzed, both together and separately.

The p -value for the domains in Tier 1 are higher than any other tier with $68 \%$ of students responding correctly for 16 items, and a p-value at $51 \%$ for the domains in Tier 2 ( 30 items), a p-value at $47 \%$ for the domains in Tier 3 ( 24 items), and a p-value of $40 \%$ for the domains in Tier 4 ( 10 items), and a total pvalue of $52 \%$ for all domains and all tiers ( 80 items). It is important to note that Tier 4 has the least number of items with $1 / 3$ as many items as Tier 2 , which has the most number of items.

|  | G | MD | NOBT | NOF | OAT |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 2 | 3 | 4 | 3 | 4 |
| Tier 2 | 3 | 7 | 3 | 8 | 9 |
| Tier 3 | 4 | 4 | 6 | 3 | 7 |
| Tier 4 | 1 | 2 | 2 | 2 | 3 |

Table 62. Grade 3 Math Items by Domain and Tier
The MC items in the domains at Tier 1 have a total p-value of $68 \%$, which is the highest percentage of students responding correctly for all 16 MC items (there are no constructed response items), a p-value of $51 \%$ at Tier 2 for 26 MC items, a p-value of $46 \%$ at Tier 3 for 22 MC items, and a p-value of $39 \%$ at Tier 4 for 9 MC items, with an overall p-value of $52 \%$ for domains by tier for all 73 MC items.

The CR items are only in the Domain of Measurement and Data in Tiers 2, 3, and 4. The highest p-value is found in Tier 2 at $54 \%$ of students responding correctly for the 4 CR items, a p-value of $51 \%$ for the 2 CR items at Tier 3, and a p-value of $50 \%$ at Tier 4 for 1 CR item. The total p-value for the CR items is $52 \%$. As noted above, there are more items in Tier 2, than Tiers 3 and 4 ; however the total number of constructed response items is seven (7).

## Grade 3 Math (p-value of domain by tier) - All items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Geometry | . 740000 | 2 |
|  | Measurement and Data | . 673333 | 3 |
|  | Number and Operations Base Ten | . 662500 | 4 |
|  | Number and Operations Fractions | . 716667 | 3 |
|  | Operations and Algebraic Thinking | . 662500 | 4 |
|  | Total | . 684375 | 16 |
| Tier 2 | Geometry | . 596667 | 3 |
|  | Measurement and Data | . 538571 | 7 |
|  | Number and Operations Base Ten | . 446667 | 3 |
|  | Number and Operations Fractions | . 416250 | 8 |
|  | Operations and Algebraic Thinking | . 574444 | 9 |
|  | Total | . 513333 | 30 |
| Tier 3 | Geometry | . 577500 | 4 |
|  | Measurement and Data | . 502500 | 4 |
|  | Number and Operations Base Ten | . 473333 | 6 |
|  | Number and Operations Fractions | . 403333 | 3 |
|  | Operations and Algebraic Thinking | . 410000 | 7 |
|  | Total | . 468333 | 24 |
| Tier 4 | Geometry | . 590000 | 1 |
|  | Measurement and Data | . 435000 | 2 |
|  | Number and Operations Base Ten | . 420000 | 2 |
|  | Number and Operations Fractions | . 390000 | 2 |
|  | Operations and Algebraic Thinking | . 323333 | 3 |
|  | Total | . 405000 | 10 |
| Total | Geometry | . 617000 | 10 |
|  | Measurement and Data | . 541875 | 16 |
|  | Number and Operations Base Ten | . 511333 | 15 |
|  | Number and Operations Fractions | . 466875 | 16 |
|  | Operations and Algebraic Thinking | . 506957 | 23 |
|  | Total | . 520500 | 80 |

[^3]
## Grade 3 Math (p-value of domain by tier) - All Items



Figure 47. Grade 3 Math Heat Maps of P-Value by Domain and Tier

Grade 3 Math (p-value of domain by tier) - MC items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Geometry | . 740000 | 2 |
|  | Measurement and Data | . 673333 | 3 |
|  | Number and Operations Base Ten | . 662500 | 4 |
|  | Number and Operations Fractions | . 716667 | 3 |
|  | Operations and Algebraic Thinking | . 662500 | 4 |
|  | Total | . 684375 | 16 |
| Tier 2 | Geometry | . 596667 | 3 |
|  | Measurement and Data | . 540000 | 3 |
|  | Number and Operations Base Ten | . 446667 | 3 |
|  | Number and Operations Fractions | . 416250 | 8 |
|  | Operations and Algebraic Thinking | . 574444 | 9 |
|  | Total | . 509615 | 26 |
| Tier 3 | Geometry | . 577500 | 4 |
|  | Measurement and Data | . 495000 | 2 |
|  | Number and Operations Base Ten | . 473333 | 6 |
|  | Number and Operations Fractions | . 403333 | 3 |
|  | Operations and Algebraic Thinking | . 410000 | 7 |
|  | Total | . 464545 | 22 |
| Tier 4 | Geometry | . 590000 | 1 |
|  | Measurement and Data | . 370000 | 1 |
|  | Number and Operations Base Ten | . 420000 | 2 |
|  | Number and Operations Fractions | . 390000 | 2 |
|  | Operations and Algebraic Thinking | . 323333 | 3 |
|  | Total | . 394444 | 9 |
| Total | Geometry | . 617000 | 10 |
|  | Measurement and Data | . 555556 | 9 |
|  | Number and Operations Base Ten | . 511333 | 15 |
|  | Number and Operations Fractions | . 466875 | 16 |
|  | Operations and Algebraic Thinking | . 506957 | 23 |
|  | Total | . 520137 | 73 |

Table 64. Grade 3 Math (p-value of domain by tier) - MC items

Grade 3 Math (p-value of domain by tier) - CR Items

| Tier | Domain | p-value | $\mathbf{N}$ |
| :--- | :--- | :---: | :---: |
| Tier 2 | Measurement and Data | .537500 | 4 |
|  | Total | .537500 | 4 |
| Tier 3 | Measurement and Data | .510000 | 2 |
|  | Total | .510000 | 2 |
| Tier 4 | Measurement and Data | .500000 | 1 |
|  | Total | .500000 | 1 |
| Total | Measurement and Data | .524286 | 7 |
|  | Total | .524286 | 7 |

Table 65. Grade 3 Math (p-value of domain by tier) - CR Items

## Distribution of Items

An analysis of the 80 items in grade 3 math shows few items below decile 3 and the bulk of the items in deciles 3-9. With the LOSS excluded, the distribution is moderate in deciles 1-3 and increases in 4-9 with a slight dip in decile 10 . The shape of this distribution differs from what was observed in ELA in that overall the items are spread more prominently in the higher regions.

Grade 3 Math Items by Decile

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 0 | 0 |
| 2 | 2 | 2.5 |
| 3 | 8 | 10.0 |
| 4 | 8 | 10.0 |
| 5 | 7 | 8.8 |
| 6 | 16 | 20.0 |
| 7 | 13 | 16.3 |
| 8 | 11 | 13.8 |
| 9 | 10 | 12.5 |
| 10 | 5 | 6.3 |
| Total | 80 | 100.0 |

Table 66. Grade 3 Math Items by Decile


Figure 48. Grade 3 Math Items by Decile
Grade 3 Math Items by Decile LOSS Excluded

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 6 | 7.5 |
| 2 | 5 | 6.3 |
| 3 | 7 | 8.8 |
| 4 | 6 | 7.5 |
| 5 | 9 | 11.3 |
| 6 | 13 | 16.3 |
| 7 | 10 | 12.5 |
| 8 | 11 | 13.8 |
| 9 | 10 | 12.5 |
| 10 | 3 | 3.8 |
| Total | 80 | 100.0 |

Table 67. Grade 3 Math Items by Decile LOSS Excluded.


Figure 49. Grade 3 Math Items by Decile LOSS Excluded

## Grade 4 Math

## Item Difficulty by Tier

We examined grade 4 Math tier and p-values to determine the percentage of students who responded correctly at each level of complexity. Tier 1 items are intended to provide the highest level of support while Tier 4 items provide the least amount of support and are therefore similar to grade level accomplishment. A total of 78 items, which represent a combination of 65 multiple choice and 13 constructed response items, were analyzed, both together and separately, to determine the p-values at each tier.

Tier 1 has the highest p-value, with $68 \%$ of students responding correctly. The highest level of support is provided for Tier1 items; therefore, it is not surprising that all 17 items are multiple choice items (selected response) and have the highest percentage of students responding correctly. The p-values are similar for Tiers 2,3 , and 4 , in which $43 \%$ of the students responded correctly at Tier $2,42 \%$ of the students responded correctly at Tier 3, and $42 \%$ of the students responded correctly at Tier 4 . Tier 2 has a total of 27 items, Tier 3 has 27 items, and Tier 4 has 7 items, which is the least number of items. The total p-value for all 78 items combined is $48 \%$.

The p-value for the multiple choice items is similar to the p -values of all items. Tier 1 has a p-value of $68 \%$, Tier 2 has $42 \%$ of students responding correctly to the 19 items, Tier 3 has $42 \%$ of students responding correctly to the 23 items, and Tier 4 has $40 \%$ of the students responding correctly to the 6 items. The total p-value for the 65 MC items is $48 \%$. It is important to note that there are a similar number of items in Tiers 1, 2, and $3(17,19,23$, respectively); however, Tier 4 has approximately $1 / 3$ the number of items as the other tiers (6).

No CR items were identified at Tier 1. The p-value at Tiers 2 and 3 were similar with $45 \%$ of students responding correctly to the 8 items in Tier 2 , and $43 \%$ of students responding correctly to the 4 items in Tier 3.Tier 4 had the least number of CR items (1) and the lowest p-value with $19 \%$ of the students responding correctly to this item.

The one (1) Tier 4 CR item has the lowest p-value at $19 \%$, whereas the six (6) Tier 4 MC items have a pvalue similar to the other tiers. It is not surprising that this item has the lowest $p$-value, as it has the least amount of complexity and support. The p-values for Tiers 2 , and 3 are similar, whether the items are MC, CR, or combined items (Tier 2 All Items p-value $=43 \%, \mathrm{MC}$ Items p -value $=42 \%, \mathrm{CR}$ Items p -value $=$ $45 \%$; Tier 3 All Items $p$-value $=42 \%$, MC Items $p$-value $=42 \%$, CR Items $p$-value $=43 \%$ ).

## Grade 4 Math ( $p$-value and tier) <br> All Items

| Tier | p-value | $\mathbf{N}$ |
| :--- | ---: | :---: |
| Tier 1 | .678235 | 17 |
| Tier 2 | .430000 | 27 |
| Tier 3 | .422593 | 27 |
| Tier 4 | .368571 | 7 |
| Total | .476026 | 78 |

Table 68. Grade 4 Math (p-value and tier) All Items


Figure 50. Grade 4 Math (p-value and tier) All Items

Grade 4 Math ( $p$-value and tier) MC Items

| Tier | p-value | N |
| :--- | :---: | :---: |
| Tier 1 | .678235 | 17 |
| Tier 2 | .420000 | 19 |
| Tier 3 | .420435 | 23 |
| Tier 4 | .398333 | 6 |
| Total | .485692 | 65 |

Table 69. Grade 4 Math (p-value and tier) MC Items


Figure 51. Grade 4 Math (p-value and tier) MC Items

Grade 4 Math ( $p$-value and tier) CR Items

| Tier | p-value | $\mathbf{N}$ |
| :--- | :---: | :---: |
| Tier 2 | .453750 | 8 |
| Tier 3 | .435000 | 4 |
| Tier 4 | .190000 | 1 |
| Total | .427692 | 13 |

Table 70. Grade 4 Math (p-value and tier) CR Items


Figure 52. Grade 4 Math (p-value and tier) CR Items
Item Difficulty by Domain
We examined grade 4 Math domains and p-values to determine the percentage of students who responded correctly for each domain. A total of 78 items, which represent a combination of 65 multiple choice and 13 constructed response items, were analyzed, both together and separately, to determine the p-values for each of the five domains, which include:

- Geometry ( 10 items)
- Measurement and Data (17 items)
- Number and Operations Base Ten (9 items)
- Number and Operations Fractions (20 items)
- Operations and Algebraic Thinking (22 items)

The p-value for several domains was similar; however there was a range from $44 \%$ to $57 \%$ of students responding correctly to the items in the domains. The Geometry Domain had the highest p-value (57\%) and the Operations and Algebraic Thinking had the lowest p-value (44\%). The Measurement and Data Domain had a p-value at 48\%, Number and Operations Base Ten Domain had a p-value at 49\%, and Number and Operations Fractions had a p-value at $46 \%$. The total p-value for all 78 items is $48 \%$.

It is important to note that the Geometry and Number and Operations Base Ten Domain have the lowest number of items ( 10 and 9 , respectively), which is $1 / 2$ as many items as the Number and Operations Fractions (20 items) and Operations and Algebraic Thinking domains ( 22 items). The Measurement and Data Domain has 17 items.

Two domains have constructed response items, which are the Geometry and Measurement and Data domains; therefore, only these two domains will be analyzed for differences in the percentage of students responding correctly to items.

The p-value for 2 MC items in the Geometry Domain is $78 \%$ and the p-value for the 8 CR items in the Geometry Domain is $52 \%$. The p-value for the 12 MC items in the Measurement and Data Domain is $57 \%$ and the p-value for the 5 CR items in the same domain is $27 \%$.

There are a significantly greater number of MC items in the Number and Operations Fractions (20) and Operations and Algebraic Thinking (22) domains compared to the Geometry Domain (2). The Measurement and Data and Number and Operations Base Ten domains have a similar number of MC items (12 and 9, respectively). There are a total of 65 MC items with $48 \%$ of students responding correctly to these items.

There are a similar number of CR items in the two domains (Geometry, 8 and Measurement and Data, 5); however, the percentage of students responding correctly to these items is quite different. The p-value for the Geometry Domain is $52 \%$, whereas the p-value for the Measurement and Data Domain is $27 \%$. There are a total of 13 CR items with $43 \%$ of students responding correctly to these items.

Grade 4 Math (p-value and domain) - All Items

| Domain | p-value | N |
| :--- | :---: | ---: |
| Geometry | .575000 | 10 |
| Measurement and Data | .481765 | 17 |
| Number and Operations Base Ten | .493333 | 9 |
| Number and Operations Fractions | .457500 | 20 |
| Operations and Algebraic Thinking | .436364 | 22 |
| Total |  | .476026 |

Table 71. Grade 4 Math (p-value and domain) - All Items


Figure 53. Grade 4 Math (p-value and domain) - All Items

Grade 4 Math ( $p$-value and domain) - MC Items

| Domain | p-value | N |
| :--- | :---: | ---: |
| Geometry | .780000 | 2 |
| Measurement and Data | .568333 | 12 |
| Number and Operations Base Ten | .493333 | 9 |
| Number and Operations Fractions | .457500 | 20 |
| Operations and Algebraic Thinking | .436364 | 22 |
| Total | .485692 | 65 |

[^4]

Figure 54. Grade 4 Math (p-value and domain) - MC Items

Grade 4 Math (p-value and domain) - CR Items

| Domain | p-value | N |
| :--- | :---: | :---: |
| Geometry | .523750 | 8 |
| Measurement and Data | .274000 | 5 |
| Total | .427692 | 13 |

[^5]

Figure 55. Grade 4 Math (p-value and domain) - CR Items

## Item Difficulty by Domain and Tier

We examined grade 4 Math p-value of domain by tier to determine the percentage of students who responded correctly for each domain at each tier level. A total of 78 items, which represent a combination of 65 multiple choice and 13 constructed response items, were analyzed, both together and separately.

The p-value for the domains in Tier 1 is higher than any other tier with $68 \%$ of students responding correctly for 17 items. The p-value for the domains in Tier 2 ( 27 items) is $43 \%$, the p-value for the domains in Tier 3 ( 27 items ) is $42 \%$, and the p-value for the domains in Tier 4 ( 7 items ) is $37 \%$. There is a p-value of $51 \%$ for the domains in Tier 2 ( 30 items), a p-value at $47 \%$ for the domains in Tier 3 (24 items), and a p-value of $40 \%$ for the domains in Tier 4 ( 10 items). The total p-value for all domains and all tiers ( 78 items) is $48 \%$. It is important to note that Tier 4 has the least number of items (7) with $1 / 2$ as many items as Tier 1 (17) and $1 / 4$ as many items as Tiers 2 and 3 ( 27 for both tiers).

|  | G | MD | NOBT | NOF | OAT |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 2 | 4 | 2 | 6 | 3 |
| Tier 2 | 4 | 7 | 3 | 6 | 7 |
| Tier 3 | 3 | 5 | 3 | 7 | 9 |
| Tier 4 | 1 | 1 | 1 | 1 | 3 |

Each domain is represented in the MC items in Tier 1, which has a total p-value of $68 \%$, the highest percentage of students responding correctly for the 17 MC items. The p -value for the 4 domains (all except Geometry) in Tier 2 is $42 \%$ for the 19 MC items, the p-value for the 4 domains in Tier 3 is $42 \%$ for the 23 MC items, and the p-value for the 4 domains in Tier 4 is $40 \%$ for the 6 MC items. The overall p-value is $48 \%$ for domains by tier for all 65 MC items. It is important to note that Tier 4 had the least number of items (6), which is approximately $1 / 3$ the number of items in the other tiers.

The CR items are in the domains of Geometry and Measurement and Data. Tier 2 has a total of 8 items from both domains, Tier 3 has a total of 4 items from both domains; however, Tier 4 has 1 CR item from only the Geometry Domain. The highest p-value is found in Tier 2 with $45 \%$ of students responding correctly for the 8 CR items. Tier 3 has a total p-value at $43 \%$ for the 4 CR items, and Tier 4 has a p-value of $19 \%$ for the 1 CR item. As noted above, Tier 4 has 1 item, Tier 3 has 4 items, and Tier 2 has 8 items. The total p-value for the CR items is $43 \%$ for the 13 CR items.

## Grade 4 Math (p-value of domain by tier) - All items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Geometry | 0.780000 | 2 |
|  | Measurement and Data | 0.735000 | 4 |
|  | Number and Operations Base Ten | 0.615000 | 2 |
|  | Number and Operations Fractions | 0.625000 | 6 |
|  | Operations and Algebraic Thinking | 0.683333 | 3 |
|  | Total | 0.678235 | 17 |
| Tier 2 | Geometry | 0.625000 | 4 |
|  | Measurement and Data | 0.371429 | 7 |
|  | Number and Operations Base Ten | 0.503333 | 3 |
|  | Number and Operations Fractions | 0.371667 | 6 |
|  | Operations and Algebraic Thinking | 0.395714 | 7 |
|  | Total | 0.430000 | 27 |
| Tier 3 | Geometry | 0.500000 | 3 |
|  | Measurement and Data | 0.440000 | 5 |
|  | Number and Operations Base Ten | 0.416667 | 3 |
|  | Number and Operations Fractions | 0.394286 | 7 |
|  | Operations and Algebraic Thinking | 0.411111 | 9 |
|  | Total | 0.422593 | 27 |
| Tier 4 | Geometry | 0.190000 | 1 |
|  | Measurement and Data | 0.450000 | 1 |
|  | Number and Operations Base Ten | 0.450000 | 1 |
|  | Number and Operations Fractions | 0.410000 | 1 |
|  | Operations and Algebraic Thinking | 0.360000 | 3 |
|  | Total | 0.368571 | 7 |
| Total | Geometry | 0.575000 | 10 |
|  | Measurement and Data | 0.481765 | 17 |
|  | Number and Operations Base Ten | 0.493333 | 9 |
|  | Number and Operations Fractions | 0.457500 | 20 |
|  | Operations and Algebraic Thinking | 0.436364 | 22 |
|  | Total | 0.476026 | 78 |

Table 75. Grade 4 Math (p-value of domain by tier) - All items

## Grade 4 Math (p-value of domain by tier) - All Items



Figure 56. Grade 4 Math Heat Map of P-Value by Domain and Tier

Grade 4 Math ( $p$-value of domain by tier) - MC items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Geometry | 0.780000 | 2 |
|  | Measurement and Data | 0.735000 | 4 |
|  | Number and Operations Base Ten | 0.615000 | 2 |
|  | Number and Operations Fractions | 0.625000 | 6 |
|  | Operations and Algebraic Thinking | 0.683333 | 3 |
|  | Total | 0.678235 | 17 |
| Tier 2 | Measurement and Data | 0.490000 | 3 |
|  | Number and Operations Base Ten | 0.503333 | 3 |
|  | Number and Operations Fractions | 0.371667 | 6 |
|  | Operations and Algebraic Thinking | 0.395714 | 7 |
|  | Total | 0.420000 | 19 |
| Tier 3 | Measurement and Data | 0.490000 | 4 |
|  | Number and Operations Base Ten | 0.416667 | 3 |
|  | Number and Operations Fractions | 0.394286 | 7 |
|  | Operations and Algebraic Thinking | 0.411111 | 9 |
|  | Total | 0.420435 | 23 |
| Tier 4 | Measurement and Data | 0.450000 | 1 |
|  | Number and Operations Base Ten | 0.450000 | 1 |
|  | Number and Operations Fractions | 0.410000 | 1 |
|  | Operations and Algebraic Thinking | 0.360000 | 3 |
|  | Total | 0.398333 | 6 |
| Total | Geometry | 0.780000 | 2 |
|  | Measurement and Data | 0.568333 | 12 |
|  | Number and Operations Base Ten | 0.493333 | 9 |
|  | Number and Operations Fractions | 0.457500 | 20 |
|  | Operations and Algebraic Thinking | 0.436364 | 22 |
|  | Total | 0.485692 | 65 |

Table 76. Grade 4 Math (p-value of domain by tier) - MC items

Grade 4 Math (p-value of domain by tier) - CR items

| Tier | Domain |  | p-value | N |
| :--- | :--- | :--- | :---: | :---: |
| Tier 2 | Geometry | 0.625000 | 4 |  |
|  | Measurement and Data | 0.282500 | 4 |  |
|  |  | Total | 0.453750 | 8 |
| Tier 3 | Geometry |  | 0.500000 | 3 |
|  | Measurement and Data | 0.240000 | 1 |  |
|  |  | Total | 0.435000 | 4 |
| Tier 4 | Geometry |  | 0.190000 | 1 |
|  |  | Total | 0.190000 | 1 |
| Total | Geometry |  | 0.523750 | 8 |
|  | Measurement and Data | 0.274000 | 5 |  |
|  |  | Total | 0.427692 | 13 |

Table 77. Grade 4 Math ( $p$-value of domain by tier) - CR items

## Distribution of Items

78 items were analyzed in grade 4 math. As expected, no items are in decile 1 when the LOSS is included. Otherwise, there is a good spread of items in deciles 2-10, with the bulk of the items in deciles $7-10$. This pattern holds when the LOSS is excluded, except that the distribution across deciles $1-5$ is relatively even, and then increases for deciles 6-10.

Grade 4 Math Items by Decile

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 0 | 0 |
| 2 | 7 | 9.0 |
| 3 | 4 | 5.1 |
| 4 | 7 | 9.0 |
| 5 | 2 | 2.6 |
| 6 | 5 | 6.4 |
| 7 | 14 | 17.9 |
| 8 | 8 | 10.3 |
| 9 | 19 | 24.4 |
| 10 | 12 | 15.4 |
| Total | 78 | 100.0 |

Table 78. Grade 4 Math Items by Decile.


Figure 57. Grade 4 Math Items by Decile.

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 7 | 8.974359 |
| 2 | 4 | 5.1 |
| 3 | 5 | 6.4 |
| 4 | 4 | 5.1 |
| 5 | 4 | 5.1 |
| 6 | 10 | 12.8 |
| 7 | 5 | 6.4 |
| 8 | 11 | 14.1 |
| 9 | 16 | 20.5 |
| 10 | 12 | 15.4 |
| Total | 78 | 100.0 |

Table 79. Grade 4 Math Items by Decile LOSS Excluded.


Figure 58. Grade 4 Math Items by Decile LOSS Excluded.
Grade 5 Math

## Item Difficulty by Tier

We examined grade 5 Math tier and p-values to determine the percentage of students who responded correctly at each level of complexity. Tier 1 items are intended to provide the highest level of support while Tier 4 items provide the least amount of support and are therefore similar to grade level accomplishment. A total of 80 items, which represent a combination of 77 multiple choice and 3 constructed response items, were analyzed, both together and separately, to determine the p-values at each tier.

The $p$-values of Tiers 3 and 4 are similar and are lower than the $p$-values of Tiers 1 and 2. The highest percentage of students responding correctly is on the 17 items in Tier 1 , with a p-value of $69 \%$ and the p value for the 28 items in Tier 2 is $46 \%$. The p-value for the 27 items in Tier 3 is $38 \%$, and the $p$-value for the 8 items in Tier 4 is $38 \%$. The highest level of support is provided for Tier 1 items; therefore, it is not surprising that all 17 items are multiple choice items (selected response) and have the highest percentage of students responding correctly. The total p-value for all 80 items is $47 \%$.

The p-value at Tiers 3 and 4 are also similar for the MC items only, with $38 \%$ of the students responding correctly at Tier 3 and $40 \%$ of the students responding correctly at Tier 4 . The $p$-value for Tier 1 is the highest with $69 \%$ of the students responding correctly, and the p-value for Tier 2 is $46 \%$ of the students responding correctly. As noted above, all 17 Tier 1 items are multiple choice. There are 28 items in Tier 2, 25 items in Tier 3, and 7 items in Tier 4. Although there is a similarity of the percentage of students responding correctly for Tiers 3 and 4, Tier 4 has approximately $1 / 4$ the number of items as Tier 3, and also $1 / 4$ as many items as Tier 2, and approximately $1 / 2$ as many items as Tier 1 . The total $p$-value for the 77 MC items is $48 \%$.

No CR response items were identified at Tier 1 or Tier 2. The p-value at Tiers 3 and 4 were similar, with a p-value of $28 \%$ at Tier 3 and $25 \%$ at Tier 4. There are 2 items in Tier 3 and 1 item in Tier 4, with a total
of 3 CR items. The total p-value for these items is $27 \%$. The three (3) CR items have the lowest percentage of students responding correctly, whether in Tier 3 or Tier 4. It is not surprising that these items have the lowest p-value, as they have the least amount of complexity and support.

Grade 5 Math ( $p$-value and tier) All Items

| Tier | p-value | $\mathbf{N}$ |
| :--- | ---: | :---: |
| Tier 1 | .687647 | 17 |
| Tier 2 | .458571 | 28 |
| Tier 3 | .377037 | 27 |
| Tier 4 | .378750 | 8 |
| Total | .471750 | 80 |

Table 80. Grade 5 Math (p-value and tier) All Items


Figure 59. Grade 5 Math (p-value and tier) All Items

Grade 5 Math (p-value and tier) MC Items

| Tier | p-value | $\mathbf{N}$ |
| :--- | :---: | :---: |
| Tier 1 | .687647 | 17 |
| Tier 2 | .458571 | 28 |
| Tier 3 | .384800 | 25 |
| Tier 4 | .397143 | 7 |
| Total | .479610 | 77 |

Table 81. Grade 5 Math (p-value and tier) MC Items


Figure 60. Grade 5 Math (p-value and tier) MC Items

Grade 5 Math ( $p$-value and tier) CR Items

| Tier | p-value | N |
| :--- | :---: | :---: |
| Tier 3 | .280000 | 2 |
| Tier 4 | .250000 | 1 |
| Total | .270000 | 3 |

[^6]

Figure 61. Grade 5 Math (p-value and tier) CR Items

## Item Difficulty by Domain

We examined grade 5 Math domains and p-values to determine the percentage of students who responded correctly for each domain. A total of 80 items, which represent a combination of 77 multiple choice and 3 constructed response items, were analyzed, both together and separately, to determine the p-values for each of the five domains, which include:

- Geometry (8 items)
- Measurement and Data (16 items)
- Number and Operations Base Ten (33 items)
- Number and Operations Fractions (16 items)
- Operations and Algebraic Thinking (7 items)

The p-value for several domains was similar; however there was a range from $41 \%$ to $50 \%$ of students responding correctly to the items in the domains. The Geometry Domain had the lowest p-value ( $41 \%$ ), which is the opposite of what was found in grades 3 and 4, in which the highest percentage of students responded correctly to the items in Geometry Domain. Number and Operations Base Ten had the highest p-value ( $50 \%$ ). The Measurement and Data Domain had a p-value at $46 \%$, Number and Operations Fractions Domain had a p-value at $58 \%$, and Operations and Algebraic Thinking had a p-value at $42 \%$. The total p-value for all 80 items is $47 \%$.

It is important to note that the Geometry Domain and Operations and Algebraic Thinking have the least number of items ( 8 and 7, respectively) with $1 / 2$ as many items as the Measurement and Data Domain (16 items) and Number and Operations Fractions Domain ( 16 items). The Number and Operations Base Ten Domain has 33 items, which is twice as many as two domains and approximately four times as many items as the other two domains.

The only domain that contains constructed response items is the Geometry Domain, in which 3 of the 8 items are CR. The 5 MC items for the Geometry Domain have a p-value of $50 \%$, whereas the p -value for the 3 CR items for the Geometry Domain is $27 \%$. It is important to note that the number of items is similar even though there is a wide discrepancy in the p -values. The total p -value for MC items is $48 \%$.

Grade 5 Math (p-value and domain) - All Items

| Domain | p-value | N |
| :--- | :---: | :---: |
| Geometry | .415000 | 8 |
| Measurement and Data | .460000 | 16 |
| Number and Operations Base Ten | .496364 | 33 |
| Number and Operations Fractions | .482500 | 16 |
| Operations and Algebraic Thinking | .422857 | 7 |
| Total |  | .471750 |

Table 83. Grade 5 Math (p-value and domain) - All Items


Figure 62. Grade 5 Math (p-value and domain) - All Items

Grade 5 Math (p-value and domain) - MC Items

| Domain | p-value | N |
| :--- | :---: | :---: |
| Geometry | .502000 | 5 |
| Measurement and Data | .460000 | 16 |
| Number and Operations Base Ten | .496364 | 33 |
| Number and Operations Fractions | .482500 | 16 |
| Operations and Algebraic Thinking | .422857 | 7 |
| Total |  | .479610 |

Table 84. Grade 5 Math (p-value and domain) - MC Items


Figure 63. Grade 5 Math (p-value and domain) - MC Items

Grade 5 Math ( $p$-value and domain) - CR Items

| Domain | p-value | N |
| :--- | :---: | :---: |
| Geometry | .270000 | 3 |
| Total | .270000 | 3 |

Table 85. Grade 5 Math (p-value and domain) - CR Items

## Item Difficulty by Domain and Tier

We examined grade 5 Math p-value of domain by tier to determine the percentage of students who responded correctly for each domain at each tier level. A total of 80 items, which represent a combination of 77 multiple choice and 3 constructed response items, were analyzed, both together and separately.

The p-value for the domains in Tier 1 are higher than any other tier with $69 \%$ of students responding correctly for 17 items, and a p-value at $46 \%$ for the domains in Tier 2 ( 28 items), a p-value at $38 \%$ for the domains in Tier 3 ( 27 items), a p-value of $38 \%$ for the domains in Tier 4 ( 8 items), and a total p-value of $47 \%$ for all domains and all tiers ( 80 items). It is important to note that Tier 4 has the least number of items with $1 / 2$ as many items as Tier 1 and approximately $1 / 3$ as many items as Tier 2 and 3, which have the most number of items.

|  | G | MD | NOBT | NOF | OAT |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 1 | 4 | 7 | 4 | 1 |
| Tier 2 | 4 | 6 | 10 | 7 | 1 |
| Tier 3 | 2 | 5 | 12 | 4 | 4 |
| Tier 4 | 1 | 1 | 4 | 1 | 1 |

Table 86. Grade 5 Math Items by Domain and Tier
The MC items in the domains at Tier 1 have a total p-value of $69 \%$, which is the highest percentage of students responding correctly for all 17 MC items (there are no constructed response items). The p-value for Tier 2 is $46 \%$ for 28 MC items. The p-value for Tier 3 is $38 \%$ for 25 MC items. There is a p-value of $40 \%$ at Tier 4 for 7 MC items, with an overall p-value of $48 \%$ for domains by tier for all 77 MC items.

The CR items are only in the Domain of Geometry in Tiers 3, and 4. There are a total of three (3) CR items with 2 items in Tier 3 and 1 item in Tier 4 . The percentage of students scoring correctly on these items is similar for both tiers, with a p-value of $28 \%$ in Tier 3 and $25 \%$ in Tier 4 , and a total p-value for all 3 CR items at $27 \%$.

## Grade 5 Math (p-value of domain by tier) - All items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Geometry | . 680000 | 1 |
|  | Measurement and Data | . 682500 | 4 |
|  | Number and Operations Base Ten | . 735714 | 7 |
|  | Number and Operations Fractions | . 607500 | 4 |
|  | Operations and Algebraic Thinking | . 700000 | 1 |
|  | Total | . 687647 | 17 |
| Tier 2 | Geometry | . 457500 | 4 |
|  | Measurement and Data | . 401667 | 6 |
|  | Number and Operations Base Ten | . 488000 | 10 |
|  | Number and Operations Fractions | . 455714 | 7 |
|  | Operations and Algebraic Thinking | . 530000 | 1 |
|  | Total | . 458571 | 28 |
| Tier 3 | Geometry | . 280000 | 2 |
|  | Measurement and Data | . 370000 | 5 |
|  | Number and Operations Base Ten | . 390000 | 12 |
|  | Number and Operations Fractions | . 407500 | 4 |
|  | Operations and Algebraic Thinking | . 365000 | 4 |
|  | Total | . 377037 | 27 |
| Tier 4 | Geometry | . 250000 | 1 |
|  | Measurement and Data | . 370000 | 1 |
|  | Number and Operations Base Ten | . 417500 | 4 |
|  | Number and Operations Fractions | . 470000 | 1 |
|  | Operations and Algebraic Thinking | . 270000 | 1 |
|  | Total | . 378750 | 8 |
| Total | Geometry | . 415000 | 8 |
|  | Measurement and Data | . 460000 | 16 |
|  | Number and Operations Base Ten | . 496364 | 33 |
|  | Number and Operations Fractions | . 482500 | 16 |
|  | Operations and Algebraic Thinking | . 422857 | 7 |
|  | Total | . 471750 | 80 |

[^7]
## Grade 5 Math (p-value of domain by tier) - All Items



Figure 64. Grade 5 Math Heat Map of P-Value by Domain and Tier

Grade 5 Math (p-value of domain by tier) - MC items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Geometry | . 680000 | 1 |
|  | Measurement and Data | . 682500 | 4 |
|  | Number and Operations Base Ten | . 735714 | 7 |
|  | Number and Operations Fractions | . 607500 | 4 |
|  | Operations and Algebraic Thinking | . 700000 | 1 |
|  | Total | . 687647 | 17 |
| Tier 2 | Geometry | . 457500 | 4 |
|  | Measurement and Data | . 401667 | 6 |
|  | Number and Operations Base Ten | . 488000 | 10 |
|  | Number and Operations Fractions | . 455714 | 7 |
|  | Operations and Algebraic Thinking | . 530000 | 1 |
|  | Total | . 458571 | 28 |
| Tier 3 | Measurement and Data | . 370000 | 5 |
|  | Number and Operations Base Ten | . 390000 | 12 |
|  | Number and Operations Fractions | . 407500 | 4 |
|  | Operations and Algebraic Thinking | . 365000 | 4 |
|  | Total | . 384800 | 25 |
| Tier 4 | Measurement and Data | . 370000 | 1 |
|  | Number and Operations Base Ten | . 417500 | 4 |
|  | Number and Operations Fractions | . 470000 | 1 |
|  | Operations and Algebraic Thinking | . 270000 | 1 |
|  | Total | . 397143 | 7 |
| Total | Geometry | . 502000 | 5 |
|  | Measurement and Data | . 460000 | 16 |
|  | Number and Operations Base Ten | . 496364 | 33 |
|  | Number and Operations Fractions | . 482500 | 16 |
|  | Operations and Algebraic Thinking | . 422857 | 7 |
|  | Total | . 479610 | 77 |

Table 88. Grade 5 Math ( $p$-value of domain by tier) - MC items

Grade 5 Math (p-value of domain by tier) - CR Items

| Tier | Domain | p-value | $\mathbf{N}$ |
| :--- | :--- | :---: | :---: |
| Tier 3 | Geometry | .280000 | 2 |
|  | Total | .280000 | 2 |
| Tier 4 | Geometry | .250000 | 1 |
|  | Total | .250000 | 1 |
| Total | Geometry | .270000 | 3 |
|  | Total | .270000 | 3 |

Table 89. Grade 5 Math (p-value of domain by tier) - CR Items

## Distribution of Items

80 items were analyzed in grade 5 math. As expected, no items are in decile 1 when the LOSS is included. Fewer items are in deciles $2-5$, and the majority are distributed in deciles 6-10. This pattern holds when LOSS is excluded, except that 3 items shift to decile 1 . It is noteworthy that there is a spike in decile 2 .

Grade 5 Math Items by Decile

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 0 | 0 |
| 2 | 3 | 3.8 |
| 3 | 10 | 12.5 |
| 4 | 3 | 3.8 |
| 5 | 2 | 2.5 |
| 6 | 10 | 12.5 |
| 7 | 11 | 13.8 |
| 8 | 11 | 13.8 |
| 9 | 12 | 15.0 |
| 10 | 18 | 22.5 |
| Total | 80 | 100.0 |

Table 90. Grade 5 Math Items by Decile


Figure 65. Grade 5 Math Items by Decile

Grade 5 Math Items by Decile LOSS Excluded

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 3 | 3.75 |
| 2 | 10 | 12.5 |
| 3 | 3 | 3.8 |
| 4 | 2 | 2.5 |
| 5 | 4 | 5.0 |
| 6 | 7 | 8.8 |
| 7 | 15 | 18.8 |
| 8 | 8 | 10.0 |
| 9 | 14 | 17.5 |
| 10 | 14 | 17.5 |
| Total | 80 | 100.0 |

Table 91. Grade 5 Math Items by Decile LOSS Excluded


Figure 66. Grade 5 Math Items by Decile LOSS Excluded

## Grade 6 Math

## Item Difficulty by Tier

We examined grade 6 Math tier and p-values to determine the percentage of students who responded correctly at each level of complexity. Tier 1 items are intended to provide the highest level of support while Tier 4 items provide the least amount of support and are therefore similar to grade level accomplishment. A total of 79 items, all multiple choice items, were analyzed to determine the p-values at each tier.

The p-values vary at all tiers, in which $73 \%$ of the students responded correctly at Tier $1,56 \%$ of the students responded correctly at Tier $2,48 \%$ of the students responded correctly at Tier 3 , and $44 \%$ of the students responded correctly at Tier 4 . The highest level of support is provided for Tier1 items; therefore, it is not surprising that all 15 items are multiple choice items (selected response) and have the highest percentage of students responding correctly. Tier 2 has a total of 28 items, Tier 3 has 28 items, and Tier 4 has 8 items, which is the least number of items. The total p-value for all 79 items is $55 \%$. It is important to note that the number of items in Tier 4 is $1 / 2$ the number of items in Tier $1(15)$, and $1 / 3$ the number of items in Tiers 2 and 3 (28 items in each).

## Grade 6 Math ( $p$-value and tier) All Items

| Tier | p-value | $\mathbf{N}$ |
| :--- | :---: | :---: |
| Tier 1 | 0.732667 | 15 |
| Tier 2 | 0.558929 | 28 |
| Tier 3 | 0.478571 | 28 |
| Tier 4 | 0.442500 | 8 |
| Total | 0.551646 | 79 |

Table 92. Grade 6 Math (p-value and tier) All Items

Grade 6 Math ( $p$-value and tier) - All Items


Figure 67. Grade 6 Math ( $p$-value and tier) All Items
Item Difficulty by Domain
We examined grade 6 Math domains and $p$-values to determine the percentage of students who responded correctly for each domain. A total of 79 items were analyzed to determine the p -values for each of the five domains, which include:

- Expressions and Equations (15 items)
- Geometry (8 items)
- Ratio and Proportions (25 items)
- Statistics and Probability (6 items)
- The Number System (25 items)

The p-value for all five domains was similar; with a range from $53 \%$ to $57 \%$ of students responding correctly to the items in the domains. The Expressions and Equations and Geometry domains had the lowest p-value ( $53 \%$ for both) and The Number System had the highest p-value (57\%). The Ratio and Proportions Domain had a p-value at $55 \%$ and Statistics and Probability Domain had a p-value at $56 \%$. The total p-value for all 79 items is $55 \%$.

It is important to note that the Geometry Domain and Statistics and Probability Domain have $1 / 2$ as many items (8 and 6, respectively) as the Expressions and Equations Domain (15 items). Both the Ratio and Proportions and The Number System domains have an equal number of items, with 25 items in each.

Grade 6 Math (p-value and domain) - All Items

| Domain | p-value | N |
| :--- | :---: | :---: |
| Expressions and Equations | .529333 | 15 |
| Geometry | .533750 | 8 |
| Ratio and Proportions | .554800 | 25 |
| Statistics and Probability | .556667 | 6 |
| The Number System | .566400 | 25 |
| Total | .551646 | 79 |

Table 93. Grade 6 Math (p-value and domain) - All Items

Grade 6 math (p-value and domain) - All Items


Figure 68. Grade 6 Math (p-value and domain) - All Items

## Item Difficulty bye Domain and Tier

We examined grade 6 Math p-value of domain by tier to determine the percentage of students who responded correctly for each domain at each tier level.

The p-value for the domains in Tier 1 is higher than any other tier with $73 \%$ of students responding correctly for 15 items. The p-value is $56 \%$ for the domains in Tier 2 ( 28 items), the p-value is $48 \%$ for the domains in Tier 3 ( 28 items), the p-value is $53 \%$ for the domains in Tier 4 ( 15 items), and the total pvalue is $55 \%$ for all domains and all tiers ( 79 items). It is important to note that Tiers 1 and 4 have the $1 / 2$ as many items ( 15 items for both) as Tiers 2 and 3, which each have 28 items.

|  | EE | G | RP | SP | NS |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 2 | 2 | 5 | 2 | 4 |
| Tier 2 | 5 | 2 | 7 | 3 | 11 |
| Tier 3 | 6 | 3 | 11 | 1 | 7 |
| Tier 4 | 2 | 1 | 2 | 3 | 8 |

Table 94. Grade 6 Math Items by Domain and Tier

Grade 6 Math (p-value of domain by tier) - All items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Expressions and Equations | . 765000 | 2 |
|  | Geometry | . 820000 | 2 |
|  | Ratio and Proportions | . 746000 | 5 |
|  | Statistics and Probability | . 760000 | 2 |
|  | The Number System | . 642500 | 4 |
|  | Total | . 732667 | 15 |
| Tier 2 | Expressions and Equations | . 568000 | 5 |
|  | Geometry | . 480000 | 2 |
|  | Ratio and Proportions | . 590000 | 7 |
|  | Statistics and Probability | . 443333 | 3 |
|  | The Number System | . 580909 | 11 |
|  | Total | . 558929 | 28 |
| Tier 3 | Expressions and Equations | . 456667 | 6 |
|  | Geometry | . 430000 | 3 |
|  | Ratio and Proportions | . 472727 | 11 |
|  | Statistics and Probability | . 490000 | 1 |
|  | The Number System | . 525714 | 7 |
|  | Total | . 478571 | 28 |
| Tier 4 | Expressions and Equations | . 415000 | 2 |
|  | Geometry | . 380000 | 1 |
|  | Ratio and Proportions | . 405000 | 2 |
|  | Statistics and Probability | . 506667 | 3 |
|  | The Number System | . 442500 | 8 |
|  | Total | . 529333 | 15 |
| Total | Expressions and Equations | 0.529333 | 15 |
|  | Geometry | 0.533750 | 8 |
|  | Ratio and Proportions | 0.554800 | 25 |
|  | Statistics and Probability | 0.556667 | 6 |
|  | The Number System | 0.566400 | 25 |
|  | Total | 0.551646 | 79 |

[^8]
## Grade 6 Math (p-value of domain by tier) - All Items

| Math, Grade 6 |  |  |  |  | P -Value |
| :---: | :---: | :---: | :---: | :---: | :---: |
| The Number System | 0.64 <br> (4) | $\begin{aligned} & 0.58 \\ & (11) \end{aligned}$ | $\begin{gathered} 0.53 \\ (7) \end{gathered}$ | $\begin{gathered} 0.51 \\ (3) \end{gathered}$ |  |
| Statistics and Probability | $\begin{gathered} 0.76 \\ (2) \end{gathered}$ | $0.44$ <br> (3) | 0.49 <br> (1) |  | 0.7 |
| Ratio and Proportions | $\begin{gathered} 0.75 \\ (5) \end{gathered}$ | $0.59$ <br> (7) | $\begin{aligned} & 0.47 \\ & (11) \end{aligned}$ | 0.4 <br> (2) | 0.6 |
| Expressions and Equations | $\begin{gathered} 0.76 \\ (2) \end{gathered}$ | $\begin{gathered} 0.57 \\ (5) \end{gathered}$ | 0.46 <br> (6) | $0.42$ <br> (2) |  |
| Geometry | $0.82$ <br> (2) | $0.48$ <br> (2) | $0.43$ <br> (3) | $0.38$ <br> (1) | -0.3 |
|  | 1 | Tier ${ }^{3}$ |  | 4 |  |

Table 96. Grade 6 Math Heat Map of P-Value by Domain and Tier

## Distribution of Items

An analysis of the 79 items in grade 6 math shows a good spread of items across all deciles with a rise in deciles 5-7. With the LOSS included, there are no items in decile one. However, adjusting to exclude these scores, reveals a spread of items across all deciles with a peak in the middle of the distribution.

Grade 6 Math Items by Decile

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 0 | 0 |
| 2 | 8 | 10.1 |
| 3 | 7 | 8.9 |
| 4 | 7 | 8.9 |
| 5 | 12 | 15.2 |
| 6 | 12 | 15.2 |
| 7 | 13 | 16.5 |
| 8 | 9 | 11.4 |
| 9 | 4 | 5.1 |
| 10 | 7 | 8.9 |
| Total | 79 | 100.0 |

Table 97. Grade 6 Math Items by Decile


Figure 69. Grade 6 Math Items by Decile

Grade 6 Math Items by Decile LOSS Excluded

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 8 | 10.1 |
| 2 | 6 | 7.6 |
| 3 | 5 | 6.3 |
| 4 | 8 | 10.1 |
| 5 | 12 | 15.2 |
| 6 | 11 | 13.9 |
| 7 | 15 | 19.0 |
| 8 | 4 | 5.1 |
| 9 | 5 | 6.3 |
| 10 | 5 | 6.3 |
| Total | 79 | 100.0 |

Table 98. Grade 6 Math Items by Decile LOSS Excluded


Figure 70. Grade 6 Math Items by Decile LOSS Excluded

## Grade 7 Math

## Item Difficulty by Tier

We examined grade 7 Math tier and p-values to determine the percentage of students who responded correctly at each level of complexity. Tier 1 items are intended to provide the highest level of support while Tier 4 items provide the least amount of support and are therefore similar to grade level accomplishment. A total of 80 items, all multiple choice items, were analyzed to determine the p-values at each tier.

The p-values vary at all tiers; however, the percentage of students responding correctly is similar for Tiers 3 and 4. The p-value for Tier 1 is $73 \%$, the p -value for Tier 2 is $52 \%$ of, the p -value for Tier 3 is $45 \%$, and the p-value for Tier 4 is $46 \%$. The highest level of support is provided for Tierl items; therefore, it is not surprising that all 14 items are multiple choice items (selected response) and have the highest percentage of students responding correctly. Tier 2 has a total of 32 items, Tier 3 has 29 items, and Tier 4 has 5 items, which is the least number of items. The total p-value for all 80 items is $53 \%$. It is important to note that the number of items in Tier 4 is $1 / 3$ the number of items in Tier 1 , and $1 / 6$ the number of items in Tiers 2 and 3.

## Grade 7 Math ( $p$-value and tier) <br> All Items

| Tier | p-value | $\mathbf{N}$ |
| :--- | :---: | :---: |
| Tier 1 | 0.732143 | 14 |
| Tier 2 | 0.523125 | 32 |
| Tier 3 | 0.448621 | 29 |
| Tier 4 | 0.462000 | 5 |
| Total | 0.528875 | 80 |

Table 99. Grade 7 Math (p-value and tier) All Items


Figure 71. Grade 7 Math (p-value and tier) All Items

## Item Difficulty by Domain

We examined grade 7 Math domains and p-values to determine the percentage of students who responded correctly for each domain. A total of 80 items were analyzed to determine the $p$-values for each of the five domains, which include:

- Expressions and Equations (10 items)
- Geometry (17 items)
- Ratio and Proportions (29 items)
- Statistics and Probability (8 items)
- The Number System (16 items)

The p-value for three domains was similar; with both Expressions and Equations and Geometry domains p-value at $54 \%$ and Ratio and Proportions Domain p-value at $53 \%$. The Statistics and Probability Domain had the highest percentage of students responding correctly with a p-value of $60 \%$ and the lowest percentage of students responding to the items in The Number System Domain with a p-value of $46 \%$. The total p-value for all 80 items is $46 \%$.

It is important to note that the Expressions and Equation Domain and the Statistics and Probability Domain had the fewest items (10 and 8 items, respectively). This number of items is approximately $1 / 2$ the number of items as found in the Geometry Domain (17 items) and the Number System Domain 16 items). The Ratio and Proportions Domain has the most items (29).

## Grade 7 Math (p-value and domain) - All Items

| Domain | p-value | $\mathbf{N}$ |
| :--- | :---: | :---: |
| Expressions and Equations | 0.536000 | 10 |
| Geometry | 0.544706 | 17 |
| Ratio and Proportions | 0.534483 | 29 |
| Statistics and Probability | 0.598750 | 8 |
| The Number System | 0.462500 | 16 |
| Total | 0.528875 | 80 |

Table 100. Grade 7 Math (p-value and domain) - All Items


Figure 72. Grade 7 Math (p-value and domain) - All Items

## Item Difficulty bye Domain and Tier

We examined grade 7 Math $p$-value of domain by tier to determine the percentage of students who responded correctly for each domain at each tier level. A total of 80 items were analyzed.

The p -value for the domains in Tier 1 is higher than any other tier with $73 \%$ of students responding correctly for 14 items. The p-value is $52 \%$ for the domains in Tier 2 ( 32 items), the p-value is $45 \%$ for the domains in Tier 3 ( 29 items), the $p$-value is $46 \%$ for the domains in Tier 4 ( 5 items), and the total p-value is $53 \%$ for all domains and all tiers ( 80 items). It is important to note that there are no items for the Statistics and Probability Domain in Tier 4 and there are only 5 items in this tier from the other domains, which is $1 / 3$ the number of items as Tier 1 ( 14 items) and $1 / 5$ the number of items as Tiers 2 and 3 (32 and 29 item, respectively).

|  | EE | G | RP | SP | NS |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 2 | 3 | 6 | 1 | 2 |
| Tier 2 | 3 | 7 | 11 | 4 | 7 |
| Tier 3 | 4 | 6 | 11 | 3 | 5 |
| Tier 4 | 1 | 1 | 1 | 0 | 3 |

Grade 7 Math (p-value of domain by tier) - All items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Expressions and Equations | . 730000 | 2 |
|  | Geometry | . 693333 | 3 |
|  | Ratio and Proportions | . 760000 | 6 |
|  | Statistics and Probability | . 880000 | 1 |
|  | The Number System | . 635000 | 2 |
|  | Total | . 732143 | 14 |
| Tier 2 | Expressions and Equations | . 480000 | 3 |
|  | Geometry | . 587143 | 7 |
|  | Ratio and Proportions | . 524545 | 11 |
|  | Statistics and Probability | . 610000 | 4 |
|  | The Number System | . 425714 | 7 |
|  | Total | . 523125 | 32 |
| Tier 3 | Expressions and Equations | . 482500 | 4 |
|  | Geometry | . 450000 | 6 |
|  | Ratio and Proportions | . 425455 | 11 |
|  | Statistics and Probability | . 490000 | 3 |
|  | The Number System | . 446000 | 5 |
|  | Total | . 448621 | 29 |
| Tier 4 | Expressions and Equations | . 530000 | 1 |
|  | Geometry | . 370000 | 1 |
|  | Ratio and Proportions | . 490000 | 1 |
|  | The Number System | . 460000 | 2 |
|  | Total | . 462000 | 5 |
| Total | Expressions and Equations | . 536000 | 10 |
|  | Geometry | . 544706 | 17 |
|  | Ratio and Proportions | . 534483 | 29 |
|  | Statistics and Probability | . 598750 | 8 |
|  | The Number System | . 462500 | 16 |
|  | Total | . 528875 | 80 |

Table 102. Grade 7 Math (p-value of domain by tier) - All items

## Grade 7 Math (p-value of domain by tier) - All Items



Figure 73. Grade 7 Math Heat Map of P-Value by Domain and Tier

## Items by Decile

80 items were analyzed in grade 7 math. Except for decile 1 with the LOSS included, the distributions reveal a relatively even spread across all deciles with an increase in deciles 7-9. In both distributions, only one item is in the $10^{\text {th }}$ decile. When the LOSS is excluded, there is a particularly pronounced spike of 25 items in decile 7 .

Grade 7 Math Items by Decile

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 0 | 0 |
| 2 | 8 | 10.0 |
| 3 | 8 | 10.0 |
| 4 | 3 | 3.8 |
| 5 | 6 | 7.5 |
| 6 | 8 | 10.0 |
| 7 | 16 | 20.0 |
| 8 | 20 | 25.0 |
| 9 | 10 | 12.5 |
| 10 | 1 | 1.3 |
| Total | 80 | 100.0 |

Table 103. Grade 7 Math Items by Decile


Figure 74. Grade 7 Math Items by Decile

Grade 7 Math Items by Decile LOSS Excluded

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 8 | 10 |
| 2 | 8 | 10.0 |
| 3 | 2 | 2.5 |
| 4 | 3 | 3.8 |
| 5 | 8 | 10.0 |
| 6 | 5 | 6.3 |
| 7 | 25 | 31.3 |
| 8 | 13 | 16.3 |
| 9 | 7 | 8.8 |
| 10 | 1 | 1.3 |
| Total | 80 | 100.0 |

Table 104. Grade 7 Math Items by Decile LOSS Excluded

# Number of Items by Ability Decile Grade 7 Math (LOSS Excluded) 



Figure 75. Grade 7 Math Items by Decile LOSS Excluded

## Grade 8 Math

## Item Difficulty by Tier

We examined grade 8 Math tier and $p$-values to determine the percentage of students who responded correctly at each level of complexity. Tier 1 items are intended to provide the highest level of support
while Tier 4 items provide the least amount of support and are therefore similar to grade level accomplishment. A total of 79 items, which represent a combination of 76 multiple choice and 3 constructed response items, were analyzed, both together and separately, to determine the p-values at each tier.

The $p$-values of Tiers 2, 3 and 4 are similar and are lower than the $p$-value of Tier 1. The highest percentage of students responding correctly is on the 16 items in Tier 1 , which has a p-value of $68 \%$. The p-value for the 27 items in Tier 2 is $50 \%$, the p-value for the 30 items in Tier 3 is $45 \%$, and the $p$-value for the 6 items in Tier 4 is $41 \%$. The highest level of support is provided for Tier 1 items; therefore, it is not surprising that all 16 items are multiple choice items (selected response) and have the highest percentage of students responding correctly. The total p-value for all 79 items is $51 \%$.

The p-value at Tiers 2, 3 and 4 are also similar for the MC items only, with $50 \%$ of the students responding correctly at Tier 2, 45\% of the students responding correctly at Tier 3, and $40 \%$ of the students responding correctly at Tier 4 . The p-value for Tier 1 is the highest with $68 \%$ of the students responding correctly. As noted above, all 16 Tier1 items are multiple choice. There are 27 items in Tier 2, 28 items in Tier 3, and 5 items in Tier 4. Although there is a similarity of the percentage of students responding correctly for Tiers 2,3 and 4 , Tier 4 has approximately $1 / 3$ the number of items as Tier 1 , and approximately $1 / 5$ as many items as Tiers 2 and 3 ( 27 and 28 items, respectively). The total p-value for the 76 MC items is $51 \%$.

No CR response items were identified at Tier 1 or Tier 2 . The p -value at Tiers 3 and 4 were similar, with a p-value of $50 \%$ at Tier 3 and $48 \%$ at Tier 4. There are 2 items in Tier 3 and 1 item in Tier 4, with a total of 3 CR items. The total p -value for these items is $50 \%$. The three (3) CR items have a greater percentage of students responding correctly than students responding to MC items in the same tiers (MC items in Tier 3 = p-value of $44 \%$ and MC items in Tier $4=p$-value o $40 \%$ ).

## Grade 8 Math ( p -value and tier) All Items

| Tier | p-value | $\mathbf{N}$ |
| :--- | :---: | :---: |
| Tier 1 | .676250 | 16 |
| Tier 2 | .496667 | 27 |
| Tier 3 | .449333 | 30 |
| Tier 4 | .413333 | 6 |
| Total | .508734 | 79 |

Table 105. Grade 8 Math (p-value and tier) All Items


Figure 76. Grade 8 Math ( $p$-value and tier) All Items

## Grade 8 Math ( $p$-value and tier) MC Items

| Tier | p-value | $\mathbf{N}$ |
| :--- | :---: | :---: |
| Tier 1 | .676250 | 16 |
| Tier 2 | .496667 | 27 |
| Tier 3 | .445357 | 28 |
| Tier 4 | .400000 | 5 |
| Total | .509211 | 76 |

[^9]Grade 8 Math (p-value and tier) - MC Items


Figure 77. Grade 8 Math (p-value and tier) MC Items

## Grade 8 Math ( $p$-value and tier)

 CR Items| Tier | p-value | $\mathbf{N}$ |
| :--- | :---: | :---: |
| Tier 3 | .505000 | 2 |
| Tier 4 | .480000 | 1 |
| Total | .496667 | 3 |

Table 107. Grade 8 Math ( $p$-value and tier) CR Items


Figure 78. Grade 8 Math (p-value and tier) CR Items

## Item Difficulty by Domain

We examined grade 8 Math domains and p-values to determine the percentage of students who responded correctly for each domain. A total of 79 items, which represent a combination of 76 multiple choice and 3 constructed response items, were analyzed, both together and separately, to determine the p-values for each of the five domains, which include:

- Expressions and Equations (14 items)
- Functions ( 16 items)
- Geometry (24 items)
- Statistics and Probability (17 items)
- The Number System (8 items)

The p-value for several domains was similar; however there was a range from $44 \%$ to $54 \%$ of students responding correctly to the items in the domains. The Geometry Domain had the highest p-value (54\%) and the Expressions and Equations Domain had the lowest p-value (44\%). The Functions Domain had a p-value at $50 \%$, Statistics and Probability Domain had a p-value at $52 \%$, and The Number System Domain had a p-value at $51 \%$. The total p-value for all 79 items is $52 \%$.

It is important to note that The Number System Domain has approximately $1 / 2$ as many items (8) as the Expressions and Equations Domain (14 items), the Functions Domain ( 15 items), and the Statistics and Probability Domain ( 17 items ), and $1 / 3$ the number of items as the Geometry Domain, which has the most number items(24 items).

The only domain that contains constructed response items is the Statistics and Probability Domain, in which approximately $1 / 5$ of the 17 items are constructed response (3) and the remainder are multiple choice items (14). The percentage of students responding correctly is similar with a p-value of $52 \%$ for the 14 multiple choice items is and a p-value of $50 \%$ for the 3 constructed response items. The total pvalue for the MC items is $51 \%$.

Grade 8 Math (p-value and domain) - All Items

| Domain | p-value | $\mathbf{N}$ |
| :--- | :---: | :---: |
| Expressions and Equations | .440714 | 14 |
| Functions | .501250 | 16 |
| Geometry | .545833 | 24 |
| Statistics and Probability | .518824 | 17 |
| The Number System | .510000 | 8 |
| Total | .508734 | 79 |

Table 108. Grade 8 Math (p-value and domain) - All Items


Figure 79. Grade 8 Math (p-value and domain) - All Items

Grade 8 Math (p-value and domain) - MC Items

| Domain | p-value | N |
| :--- | :---: | :---: |
| Expressions and Equations | .440714 | 14 |
| Functions | .501250 | 16 |
| Geometry | .545833 | 24 |
| Statistics and Probability | .523571 | 14 |
| The Number System | .510000 | 8 |
| Total |  | .509211 |

Table 109. Grade 8 Math (p-value and domain) - MC Items


Figure 80. Grade 8 Math (p-value and domain) - MC Items

Grade 8 Math (p-value and domain) - CR Items

| Domain | p-value | N |
| :--- | :---: | :---: |
| Statistics and Probability | .496667 | 3 |
| Total | .496667 | 3 |

## Item Difficulty by Domain and Tier

We examined grade 8 Math p-value of domain by tier to determine the percentage of students who responded correctly for each domain at each tier level. A total of 79 items, which represent a combination of 76 multiple choice and 3 constructed response items, were analyzed, both together and separately.

The p-value for the domains in Tier 1 are higher than any other tier with $68 \%$ of students responding correctly for 16 items. There is a p-value of $50 \%$ for the domains in Tier 2 ( 27 items), a p-value at $45 \%$ for the domains in Tier 3 ( 30 items), and a p-value of $41 \%$ for the domains in Tier 4 ( 6 items), and a total p-value of $51 \%$ for all domains and all tiers ( 79 items). It is important to note that Tier 4 has the least number of items with approximately $1 / 2$ as many items as Tier 1 (16) and $1 / 5$ as many items as Tiers 2 and 3 (27 and 30, respectively), which have the most number of items.

|  | EE | F | G | SP | NS |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 2 | 4 | 4 | 4 | 2 |
| Tier 2 | 5 | 5 | 9 | 6 | 2 |
| Tier 3 | 6 | 6 | 10 | 5 | 3 |
| Tier 4 | 1 | 1 | 1 | 2 | 1 |

Table 111. Grade 8 Math Items by Domain and Tier
The MC items in the domains at Tier 1 have a total p-value of $68 \%$, which is the highest percentage of students responding correctly for all 16 MC items (there are no constructed response items), a p-value of $50 \%$ at Tier 2 for 27 MC items, a p-value of $44 \%$ at Tier 3 for 28 MC items, and a p-value of $40 \%$ at Tier 4 for 5 MC items, with an overall p-value of $51 \%$ for domains by tier for all 76 MC items.

The CR items are only in the Domain of Statistics and Probability in Tiers 3 and 4. The highest p-value is found in Tier 3 with $50 \%$ of students responding correctly for the 2 CR items, and a p-value of $48 \%$ for the 1 CR item at Tier 4. The total p-value for the CR items is $50 \%$.

## Grade 8 Math (p-value of domain by tier) - All items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Expressions and Equations | . 530000 | 2 |
|  | Functions | . 642500 | 4 |
|  | Geometry | . 737500 | 4 |
|  | Statistics and Probability | . 667500 | 4 |
|  | The Number System | . 785000 | 2 |
|  | Total | . 676250 | 16 |
| Tier 2 | Expressions and Equations | . 408000 | 5 |
|  | Functions | . 522000 | 5 |
|  | Geometry | . 552222 | 9 |
|  | Statistics and Probability | . 491667 | 6 |
|  | The Number System | . 420000 | 2 |
|  | Total | . 496667 | 27 |
| Tier 3 | Expressions and Equations | . 436667 | 6 |
|  | Functions | . 393333 | 6 |
|  | Geometry | . 476000 | 10 |
|  | Statistics and Probability | . 488000 | 5 |
|  | The Number System | . 433333 | 3 |
|  | Total | . 449333 | 30 |
| Tier 4 | Expressions and Equations | . 450000 | 1 |
|  | Functions | . 480000 | 1 |
|  | Geometry | . 420000 | 1 |
|  | Statistics and Probability | . 380000 | 2 |
|  | The Number System | . 370000 | 1 |
|  | Total | . 413333 | 6 |
| Total | Expressions and Equations | . 440714 | 14 |
|  | Functions | . 501250 | 16 |
|  | Geometry | . 545833 | 24 |
|  | Statistics and Probability | . 518824 | 17 |
|  | The Number System | . 510000 | 8 |
|  | Total | . 508734 | 79 |

Table 112. Grade 8 Math (p-value of domain by tier) - All items

## Grade 8 Math (p-value of domain by tier) - All Items



Figure 81. Grade 8 Math Heat Map of P-Value by Domain and Tier

## Grade 11 Math (p-value of domain by tier) - MC items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Expressions and Equations | 0.530000 | 2 |
|  | Functions | 0.642500 | 4 |
|  | Geometry | 0.737500 | 4 |
|  | Statistics and Probability | 0.667500 | 4 |
|  | The Number System | 0.785000 | 2 |
|  | Total | 0.676250 | 16 |
| Tier 2 | Expressions and Equations | 0.408000 | 5 |
|  | Functions | 0.522000 | 5 |
|  | Geometry | 0.552222 | 9 |
|  | Statistics and Probability | 0.491667 | 6 |
|  | The Number System | 0.420000 | 2 |
|  | Total | 0.496667 | 27 |
| Tier 3 | Expressions and Equations | 0.436667 | 6 |
|  | Functions | 0.393333 | 6 |
|  | Geometry | 0.476000 | 10 |
|  | Statistics and Probability | 0.476667 | 3 |
|  | The Number System | 0.433333 | 3 |
|  | Total | 0.445357 | 28 |
| Tier 4 | Expressions and Equations | 0.450000 | 1 |
|  | Functions | 0.480000 | 1 |
|  | Geometry | 0.420000 | 1 |
|  | Statistics and Probability | 0.280000 | 1 |
|  | The Number System | 0.370000 | 1 |
|  | Total | 0.400000 | 5 |
| Total | Expressions and Equations | 0.440714 | 14 |
|  | Functions | 0.501250 | 16 |
|  | Geometry | 0.545833 | 24 |
|  | Statistics and Probability | 0.523571 | 14 |
|  | The Number System | 0.510000 | 8 |
|  | Total | 0.509211 | 76 |

Table 113. Grade 11 Math (p-value of domain by tier) - MC items

## Grade 11 Math (p-value of domain by tier) - CR Items

| Tier | Domain | p-value | $\mathbf{N}$ |
| :--- | :--- | :---: | :---: |
| Tier 3 | Statistics and Probability | 0.505000 | 2 |
|  | Total | 0.505000 | 2 |
| Tier 4 | Statistics and Probability | 0.480000 | 1 |
|  | Total | 0.480000 | 1 |
| Total | Statistics and Probability | 0.496667 | 3 |
|  | Total | 0.496667 | 3 |

Table 114. Grade 11 Math (p-value of domain by tier) - CR Items

## Distribution of Items

An analysis of the 79 items in grade 8 math shows a good spread of items across all deciles with an increase in deciles 6-9. With the LOSS included, there are no items in decile one. However, adjusting to exclude these scores, reveals a spread in deciles 1-4, a dip in 4, and then an increase in 6-9. This continues the pattern in mathematics of seeing more items concentrated in the higher ability regions.

Grade 8 Math Items by Decile

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 0 | 0 |
| 2 | 5 | 6.3 |
| 3 | 8 | 10.1 |
| 4 | 6 | 7.6 |
| 5 | 3 | 3.8 |
| 6 | 14 | 17.7 |
| 7 | 15 | 19.0 |
| 8 | 15 | 19.0 |
| 9 | 10 | 12.7 |
| 10 | 3 | 3.8 |
| Total | 79 | 100.0 |

Table 115. Grade 8 Math Items by Decile


Figure 82. Grade 8 Math Items by Decile

Grade 8 Math Items by Decile LOSS Excluded

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 5 | 6.329114 |
| 2 | 7 | 8.9 |
| 3 | 6 | 7.6 |
| 4 | 1 | 1.3 |
| 5 | 8 | 10.1 |
| 6 | 11 | 13.9 |
| 7 | 20 | 25.3 |
| 8 | 10 | 12.7 |
| 9 | 8 | 10.1 |
| 10 | 3 | 3.8 |
| Total | 79 | 100.0 |

Table 116. Grade 8 Math Items by Decile LOSS Excluded


Figure 83. Grade 8 Math Items by Decile LOSS Excluded

## Grade 11 Math

## Item Difficulty by Tier

We examined grade 11 Math tier and p-values to determine the percentage of students who responded correctly at each level of complexity. Tier 1 items are intended to provide the highest level of support while Tier 4 items provide the least amount of support and are therefore similar to grade level accomplishment. A total of 80 items, which represent a combination of 75 multiple choice and 5 constructed response items, were analyzed, both together and separately, to determine the p-values at each tier.

The p-values of Tiers 2, 3 and 4 are similar and are lower than the p-value of Tier 1. The highest percentage of students responding correctly is on the 14 items in Tier 1 , which has a p-value of $68 \%$. The p-value for the 30 items in Tier 2 is $47 \%$, the p-value for the 30 items in Tier 3 is $43 \%$, and the $p$-value for the 6 items in Tier 4 is $48 \%$. The highest level of support is provided for Tier 1 items; therefore, it is not surprising that all 14 items are multiple choice items (selected response) and have the highest percentage of students responding correctly. The total p-value for all 80 items is $48 \%$.

The p-value at Tiers 2, 3 and 4 are also similar for the MC items only, with $47 \%$ of the students responding correctly at Tier 2, 44\% of the students responding correctly at Tier 3, and 39\% of the students responding correctly at Tier 4 . The p-value for Tier 1 is the highest with $68 \%$ of the students responding correctly. As noted above, all 14 Tier1 items are multiple choice. There are 30 items in Tier 2, 26 items in Tier 3, and 5 items in Tier 4. Although there is a similarity of the percentage of students responding correctly for Tiers 2,3 and 4 , Tier 4 has approximately $1 / 3$ the number of items as Tier 1 , and approximately $1 / 6$ as many items as Tier 2 and $1 / 5$ as many items as Tier 3 ( 30 and 26 items, respectively). The total p-value for the 75 MC items is $49 \%$.

No CR response items were identified at Tier 1 or Tier 2. The p-value at Tiers 3 and 4 were similar, with a p-value of $40 \%$ at Tier 3 and $37 \%$ at Tier 4. There are 4 items in Tier 3 and 1 item in Tier 4, with a total of 5 CR items. The total p -value for these items is $39 \%$. The percentage of students responding correctly to the one (1) CR item in Tier 4 is similar to the p-value for the 5 MC items in Tier 4 ( $37 \%$ and $38 \%$ respectively. However, the percentage of students scoring correctly is slightly higher for the 26 MC items in Tier $3(44 \%)$ than the p -value for the four (4) constructed response items in Tier 3 ( $40 \%$ ).

Grade 11 Math (p-value and tier) All Items

| Tier | p-value | $\mathbf{N}$ |
| :--- | :---: | :---: |
| Tier 1 | .682143 | 14 |
| Tier 2 | .467667 | 30 |
| Tier 3 | .432000 | 30 |
| Tier 4 | .385000 | 6 |
| Total | .485625 | 80 |

Table 117. Grade 11 Math (p-value and tier) All Items


Figure 84. Grade 11 Math (p-value and tier) All Items

## Grade 11 Math (p-value and

 tier) MC Items| Tier | p-value | $\mathbf{N}$ |
| :--- | :---: | :---: |
| Tier 1 | .682143 | 14 |
| Tier 2 | .467667 | 30 |
| Tier 3 | .437308 | 26 |
| Tier 4 | .388000 | 5 |
| Total | .491867 | 75 |

Table 118. Grade 11 Math ( $p$-value and tier) MC Items


Figure 85. Grade 11 Math (p-value and tier) MC Items

## Grade 11 Math (p-value and

 tier) CR Items| Tier | p-value | $\mathbf{N}$ |
| :--- | :---: | :---: |
| Tier 3 | .397500 | 4 |
| Tier 4 | .370000 | 1 |
| Total | .392000 | 5 |

Table 119. Grade 11 Math (p-value and tier) CR Items

Grade 11 Math (p-value and tier) - CR Items


Figure 86. Grade 11 Math ( $p$-value and tier) CR Items

## Item Difficulty by Domain

Grade 11 Math domains and p-values were examined to determine the percentage of students who responded correctly for each domain. A total of 80 items, which represent a combination of 75 multiple choice and 5 constructed response items, were analyzed, both together and separately to determine the pvalues for each of the four domains, which include:

- Algebra and Functions (41 items)
- Geometry (8 items)
- Number and Quantity (16 items)
- Statistics and Probability ( 15 items)

The p-value for several domains was similar; however there was a range from $39 \%$ to $52 \%$ of students responding correctly to the items in the domains. The Algebra and Functions Domain had the highest pvalue ( $52 \%$ ) and the Geometry Domain had the lowest p-value ( $39 \%$ ). The Number and Quantity Domain had a p-value at $48 \%$, and Statistics and Probability Domain had a p-value at $45 \%$. The total p-value for all 80 items is $48 \%$.

It is important to note that the Geometry Domain has approximately $1 / 2$ as many items (8) as the Number and Quantity Domain ( 16 items) and the Statistics and Probability Domain (15 items). However, the Algebra and Functions Domain has over five times as many items as the Geometry Domain with a total of 41 items.

The only domain that contains constructed response items is the Statistics and Probability Domain in which $1 / 3$ of the 15 items are constructed response (5) and the remainder is multiple choice items (10). The percentage of students responding correctly to the MC items in the Statistics and Probability Domain is $48 \%$ and the p-value of the CR items in the same domain is $39 \%$. The total p-value for the MC items is $49 \%$.

Grade 11 Math (p-value and domain) - All Items

| Domain | p-value | N |
| :--- | :---: | :---: |
| Algebra and Functions | .522683 | 41 |
| Geometry | .395000 | 8 |
| Number and Quantity | .467500 | 16 |
| Statistics and Probability | .452000 | 15 |
| Total | .485625 | 80 |

Table 120. Grade 11 Math (p-value and domain) - All Items


Figure 87. Grade 11 Math (p-value and domain) - All Items

Grade 11 Math (p-value and domain) - MC Items

| Domain | p-value | N |
| :--- | :---: | :---: |
| Algebra and Functions | .522683 | 41 |
| Geometry | .395000 | 8 |
| Number and Quantity | .467500 | 16 |
| Statistics and Probability | .482000 | 10 |
| Total | .491867 | 75 |

Table 121. Grade 11 Math (p-value and domain) - MC Items


Figure 88. Grade 11 Math (p-value and domain) - MC Items

Grade 11 Math ( $p$-value and domain) - CR Items

| Domain | p-value | N |
| :--- | :---: | :---: |
| Statistics and Probability | .392000 | 5 |
| Total | .392000 | 5 |

Table 122. Grade 11 Math (p-value and domain) - CR Items

## Item Difficulty by Domain and Tier

We examined grade 11 Math p-value of domain by tier to determine the percentage of students who responded correctly for each domain at each tier level. A total of 80 items, which represent a combination of 75 multiple choice and 5 constructed response items, were analyzed, both together and separately.

The p-value for the domains in Tier 1 are higher than any other tier with $68 \%$ of students responding correctly for 14 items, and a p-value at $47 \%$ for the domains in Tier 2 ( 30 items), a p-value at $43 \%$ for the domains in Tier 3 ( 30 items), and a p-value of $38 \%$ for the domains in Tier 4 ( 6 items), and a total $p$-value of $48 \%$ for all domains and all tiers ( 80 items). It is important to note that Tier 4 has the least number of items with approximately $1 / 2$ as many items as Tier 1 (14) and $1 / 5$ as many items as Tiers 2 and 3 (30 items in each, which have the most number of items.

|  | AF | G | NQ | SP |
| :--- | :---: | :---: | :---: | :---: |
| Tier 1 | 8 | 1 | 3 | 2 |
| Tier 2 | 17 | 2 | 6 | 5 |
| Tier 3 | 14 | 4 | 6 | 6 |
| Tier 4 | 2 | 1 | 1 | 2 |

Table 123. Grade 11 Math Items by Domain and Tier
The MC items in the domains at Tier 1 has a total p-value of $68 \%$, which is the highest percentage of students responding correctly for all 14 MC items (there are no constructed response items), a p-value of $47 \%$ at Tier 2 for 30 MC items (there are no constructed response items), a p-value of $44 \%$ at Tier 3 for 26 MC items, and a p-value of $39 \%$ at Tier 4 for 5 MC items, with an overall p-value of $49 \%$ for domains by tier for all 75 MC items.

The CR items are only in the Domain of Statistics and Probability in Tiers 3 and 4. The highest p-value is found in Tier 3 with $40 \%$ of students responding correctly for the 4 CR items, and a p-value of $37 \%$ for the 1 CR item at Tier 4. The total p -value for the CR items is $39 \%$. It is important to note that the p -value for the 2 MC items in the Statistics and Probability Domain in Tier 3 is $45 \%$ which is greater than the pvalue for the 4 CR items in the same domain and tier ( $40 \%$ ); however, the p -value for the 1 CR item in the Statistics and Probability Domain in Tier 4 is $37 \%$ which is greater than the $p$-value of the 1 MC item in the same domain and tier (35\%).

## Grade 11 Math ( $p$-value of domain by tier) - All items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Algebra And Functions | . 706250 | 8 |
|  | Geometry | . 560000 | 1 |
|  | Number and Quantity | . 653333 | 3 |
|  | Statistics and Probability | . 690000 | 2 |
|  | Total | . 682143 | 14 |
| Tier 2 | Algebra And Functions | . 491765 | 17 |
|  | Geometry | . 375000 | 2 |
|  | Number and Quantity | . 455000 | 6 |
|  | Statistics and Probability | . 438000 | 5 |
|  | Total | . 467667 | 30 |
| Tier 3 | Algebra And Functions | . 466429 | 14 |
|  | Geometry | . 377500 | 4 |
|  | Number and Quantity | . 405000 | 6 |
|  | Statistics and Probability | . 415000 | 6 |
|  | Total | . 432000 | 30 |
| Tier 4 | Algebra And Functions | . 445000 | 2 |
|  | Geometry | . 340000 | 1 |
|  | Number and Quantity | . 360000 | 1 |
|  | Statistics and Probability | . 360000 | 2 |
|  | Total | . 385000 | 6 |
| Total | Algebra And Functions | . 522683 | 41 |
|  | Geometry | . 395000 | 8 |
|  | Number and Quantity | . 467500 | 16 |
|  | Statistics and Probability | . 452000 | 15 |
|  | Total | . 485625 | 80 |

Table 124. Grade 11 Math (p-value of domain by tier) - All items

Grade 11 Math (p-value of domain by tier) - All Items


Figure 89. Grade 11 Math Heat Map of P-Value by Domain and Tier

Grade 11 Math (p-value of domain by tier) - MC items

| Tier | Domain | p-value | N |
| :---: | :---: | :---: | :---: |
| Tier 1 | Algebra And Functions | . 706250 | 8 |
|  | Geometry | . 560000 | 1 |
|  | Number and Quantity | . 653333 | 3 |
|  | Statistics and Probability | . 690000 | 2 |
|  | Total | . 682143 | 14 |
| Tier 2 | Algebra And Functions | . 491765 | 17 |
|  | Geometry | . 375000 | 2 |
|  | Number and Quantity | . 455000 | 6 |
|  | Statistics and Probability | . 438000 | 5 |
|  | Total | . 467667 | 30 |
| Tier 3 | Algebra And Functions | . 466429 | 14 |
|  | Geometry | . 377500 | 4 |
|  | Number and Quantity | . 405000 | 6 |
|  | Statistics and Probability | . 450000 | 2 |
|  | Total | . 437308 | 26 |
| Tier 4 | Algebra And Functions | . 445000 | 2 |
|  | Geometry | . 340000 | 1 |
|  | Number and Quantity | . 360000 | 1 |
|  | Statistics and Probability | . 350000 | 1 |
|  | Total | . 388000 | 5 |
| Total | Algebra And Functions | . 522683 | 41 |
|  | Geometry | . 395000 | 8 |
|  | Number and Quantity | . 467500 | 16 |
|  | Statistics and Probability | . 482000 | 10 |
|  | Total | . 491867 | 75 |

Table 125. Grade 11 Math ( $p$-value of domain by tier) - MC items

## Grade 11 Math (p-value of domain by tier) - CR Items

| Tier | Domain | p-value | N |
| :--- | :--- | :---: | :---: |
| Tier 3 | Statistics and Probability | .397500 | 4 |
|  | Total | .397500 | 4 |
| Tier 4 | Statistics and Probability | .370000 | 1 |
|  | Total | .370000 | 1 |
| Total | Statistics and Probability | .392000 | 5 |
|  | Total | .392000 | 5 |

Table 126. Grade 11 Math (p-value of domain by tier) - CR Items

## Distribution of Items

80 items were analyzed in grade 11 mathematics. These results follow the pattern observed in the lower math grades. While items are distributed across all deciles when LOSS is excluded, there is an increase in deciles 7-9. The fewest items are in deciles 2-5.

Grade 11 Math Items by Decile

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 0 | 0 |
| 2 | 7 | 8.8 |
| 3 | 3 | 3.8 |
| 4 | 2 | 2.5 |
| 5 | 1 | 1.3 |
| 6 | 5 | 6.3 |
| 7 | 12 | 15.0 |
| 8 | 24 | 30.0 |
| 9 | 21 | 26.3 |
| 10 | 5 | 6.3 |
| Total | 80 | 100.0 |

Table 127. Grade 11 Math Items by Decile


Figure 90. Grade 11 Math Items by Decile

| Ability <br> Decile | Number <br> of Items | Percent <br> of Items |
| :---: | :---: | :---: |
| 1 | 7 | 8.75 |
| 2 | 3 | 3.8 |
| 3 | 1 | 1.3 |
| 4 | 1 | 1.3 |
| 5 | 4 | 5.0 |
| 6 | 8 | 10.0 |
| 7 | 16 | 20.0 |
| 8 | 19 | 23.8 |
| 9 | 17 | 21.3 |
| 10 | 4 | 5.0 |
| Total | 80 | 100.0 |

Table 128. Grade 11 Math Items by Decile LOSS Excluded


Figure 91. Grade 11 Math Items by Decile LOSS Excluded

## Phase Two Results

In this section, we discuss the results from the set of analyses designed to account for potential differences in performance due to some multiple choice items having two answer choices, the Tier 1 items, compared to those with three choices. As discussed in the methods section of this document, we produced two different calculations in lieu of $p$-values. The first is simply the p -value minus the probability of guessing based on the number of answer choices (i.e. . 5 for two choice items and .33 for three choice items). This value is termed $\mathrm{P}+$. The second calculation is termed Adjusted $\mathrm{P}+$, which attempts to address the 'ceiling effects' of P+ by dividing P+ by the maximum value (i.e. .5 for two choice items and .67 for three choice items). We believe both approaches are valuable to help understand patterns of item difficulty by tier and domain, adjusting for the potential impact of 'guessing' related to number of answer choice options.

As will be shown, both the $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ metrics are lower than p -values, which indicate a greater level of difficulty than is reflected in the p-value analyses in phase one of this study. However, we believe the relative difficulties are not as important as the pattern exhibited for each of $\mathrm{P}+$ and Adjusted $\mathrm{P}+$. For that reason, we primarily focus on outcomes within (not across) $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ for tiers and domains and the combination of tiers and domains. In the discussion section, we will compare and contrast results from phase one and phase two and reflect on implications.

## Grade 3 ELA

## Item Difficulty by Tier

A total of 58 multiple choice items were analyzed to determine the mean P+ and Adjusted P+ values at each tier.

The $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ values varied minimally across each of the tiers. $\mathrm{P}+$ is highest for Tier 2, whereas the Adjusted $\mathrm{P}+$ is highest for Tier 1. Tier 1 has 16 items with a $\mathrm{P}+$ of $27 \%$ and an Adjusted $\mathrm{P}+$
of $53 \%$. Tier 2 has 12 items with a $\mathrm{P}+$ of $28 \%$ and an Adjusted $\mathrm{P}+$ of $41 \%$. Tier 3 has the most number of items (23) and a $\mathrm{P}+$ of $24 \%$ and an Adjusted $\mathrm{P}+$ value of $35 \%$. Tier 4 has the least number of items (7) with a P+ of $27 \%$ and an Adjusted $\mathrm{P}+$ of $40 \%$. The total mean $\mathrm{P}+$ value for all 58 items is $26 \%$ and $42 \%$ for the Adjusted $\mathrm{P}+$ value.

## Grade 3 ELA - P+, Adjusted P+ and Tiers <br> (MC Items)

| Tier |  |  |  |
| :--- | :---: | :---: | :---: |
| Tier 1 | 0.2663 | 0.5325 | 16 |
| Tier 2 | 0.2767 | 0.4129 | 12 |
| Tier 3 | 0.2365 | 0.3530 | 23 |
| Tier 4 | 0.2700 | 0.4030 | 7 |
| Total | 0.2571 | 0.4210 | 58 |

Table 129. Grade 3 ELA P+ and Adjusted P+ by Tier


Figure 92. Grade 3 ELA P+ and Adjusted P+ by Tier

## Item Difficulty by Domain

A total of 58 multiple choice items were analyzed to determine the mean $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ values for each of the five domains, which include:

- Reading at Word Level (7 items)
- Reading Informational Text (22 items)
- Reading Literature (19 items)
- Writing Informational (4 items)
- Writing Prompt-Narrative (6 items)

The P+ and Adjusted P+ values varied slightly across all domains with the Writing Prompt-Narrative Domain having the lowest $\mathrm{P}+(18 \%)$ as well as the lowest Adjusted $\mathrm{P}+(36 \%)$. The Reading at Word Level Domain has the highest $\mathrm{P}+$ at $33 \%$ and Adjusted $\mathrm{P}+$ of $52 \%$. The Reading Informational Text Domain has a P+ of $24 \%$ and Adjusted P+ of $38 \%$. The Reading Literature Domain has a P+ of $26 \%$ and Adjusted P+ of 43\%, and the Writing Informational Domain has a P+ of $31 \%$ and Adjusted P+ value of $51 \%$. The total $\mathrm{P}+$ for all 58 items is $26 \%$ and the Adjusted $\mathrm{P}+$ value is $42 \%$.

## Grade 3 ELA - P+, Adjusted P+, and Domains (MC Items)

| Domain | $\mathbf{P +}$ | Adjusted $\mathbf{P}_{+}$ | $\mathbf{N}$ |
| :--- | :---: | :---: | :---: |
| Reading at Word Level | 0.3314 | 0.5229 | 7 |
| Reading Informational Text | 0.2386 | 0.3836 | 22 |
| Reading Literature | 0.2637 | 0.4272 | 19 |
| Writing Informational | 0.3125 | 0.5096 | 4 |
| Writing Prompt-Narrative | 0.1800 | 0.3600 | 6 |
| Total | 0.2571 | 0.4210 | 58 |

Table 130. Grade 3 ELA P+ and Adjusted P+ by Domain.


Figure 93. Grade 3 ELA P+ and Adjusted P+ by Domain
Item Difficulty by Domain and Tier
$\mathrm{P}+$ and Adjusted $\mathrm{P}+$ for 58 grade 3 ELA multiple choice items were examined by domain and tier.
Overall, we note modestly lower P+ and Adjusted $\mathrm{P}+$ for items in Tiers 3 and 4 across domains, especially for Adjusted $\mathrm{P}+$, but the difference is not as pronounced compared to p -values in phase one. $\mathrm{P}+$ for the domains in Tier 3 was slightly lower compared to the other tiers. Also, we note a greater difference in the Adjusted P+ for domains in each tier with $53 \%$ for Tier 1, $41 \%$ for Tier 2, 35\% for Tier 3 , and $40 \%$ for Tier 4.

|  | RWL | RIT | RL | WI | WPN |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 1 | 4 | 4 | 1 | 6 |
| Tier 2 | 1 | 10 | 0 | 1 | 0 |
| Tier 3 | 4 | 8 | 10 | 1 | 0 |
| Tier 4 | 1 | 0 | 5 | 1 | 0 |

[^10]
## Grade 3 ELA - P+, Adjusted P+ of domain by tier (MC Items)

| Tier | Domain |  |  |  |
| :--- | :--- | :---: | :---: | :---: |
|  | Reading at Word Level | 0.3900 | 0.7800 | 1 |
|  | Reading Informational Text | 0.2975 | 0.5950 | 4 |
|  | Reading Literature | 0.3150 | 0.6300 | 4 |
|  | Writing Informational | 0.3400 | 0.6800 | 1 |
|  | Writing Prompt-Narrative | 0.1800 | 0.3600 | 6 |
|  | Total | 0.2663 | 0.5325 | 16 |
| Tier 2 | Reading at Word Level | 0.4300 | 0.6418 | 1 |
|  | Reading Informational Text | 0.2440 | 0.3642 | 10 |
|  | Writing Informational | 0.4500 | 0.6716 | 1 |
|  | Total | 0.2767 | 0.4129 | 12 |
| Tier 3 | Reading at Word Level | 0.3325 | 0.4963 | 4 |
|  | Reading Informational Text | 0.2025 | 0.3022 | 8 |
|  | Reading Literature | 0.2270 | 0.3388 | 10 |
|  | Writing Informational | 0.2200 | 0.3284 | 1 |
|  | Total | 0.2365 | 0.3530 | 23 |
| Tier 4 | Reading at Word Level | 0.1700 | 0.2537 | 1 |
|  | Reading Literature | 0.2960 | 0.4418 | 5 |
|  | Writing Informational | 0.2400 | 0.3582 | 1 |
|  | Total | 0.2700 | 0.4030 | 7 |
| Total | Reading at Word Level | 0.3314 | 0.5229 | 7 |
|  | Reading Informational Text | 0.2386 | 0.3836 | 22 |
|  | Reading Literature | 0.2637 | 0.4272 | 19 |
|  | Writing Informational | 0.3125 | 0.5096 | 4 |
|  | Writing Prompt-Narrative | 0.1800 | 0.3600 | 6 |
|  |  | 0.2571 | 0.4210 | 58 |

Table 132. Grade 3 ELA P+ and Adjusted P+ by Domain and Tier


Figure 94. Grade 3 ELA Heat Map of P+ by Domain and Tier


Figure 95. Grade 3 ELA Heat Map of Adjusted P+ by Domain and Tier
Grade 5 ELA

## Item Difficulty by Tier

A total of 61 multiple choice items were analyzed to determine the mean $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ for each tier. The P+ and Adjusted P+ varied slightly across all tiers; however, there was a larger difference between the Tier 1 and Tier 4 Adjusted $\mathrm{P}+$ values. Values are highest for Tier 1, with a P+ value of $27 \%$ and an Adjusted $\mathrm{P}+$ value of $54 \%$ for the 14 items. There are 12 items in Tier 2 with a $\mathrm{P}+$ of $20 \%$ and an Adjusted $\mathrm{P}+$ of $30 \%$. $\mathrm{P}+$ for Tier 3 is $20 \%$ and the Adjusted $\mathrm{P}+$ is $29 \%$ for the 27 items. Tier 4 has the least number of items and the lowest values. The $\mathrm{P}+$ for this tier is $16 \%$ and the Adjusted $\mathrm{P}+\mathrm{is} 24 \%$. The total $\mathrm{P}+$ for all 61 items is $21 \%$ and $34 \%$ for the Adjusted $\mathrm{P}+$.

## Grade 5 ELA - P+, Adjusted P+ and Tiers

 (MC Items)| Tier | $\mathbf{P}$ | Adjusted <br> $\mathbf{P}+$ | $\mathbf{N}$ |
| :--- | :---: | :---: | :---: |
| Tier 1 | 0.2686 | 0.5371 | 14 |
| Tier 2 | 0.2017 | 0.3010 | 12 |
| Tier 3 | 0.1952 | 0.2913 | 27 |
| Tier 4 | 0.1625 | 0.2425 | 8 |
| Total | 0.2090 | 0.3432 | 61 |

Table 133. Grade 5 ELA P+ and Adjusted P+ by Tier


Figure 96. Grade 5 ELA P+ and Adjusted P+ by Tier

## Item Difficulty by Domain

$\mathrm{P}+$ and Adjusted $\mathrm{P}+$ were examined for each domain of the following domains.

- Reading at Word Level (8 items)
- Reading Informational Text (21 items)
- Reading Literature (24items)
- Writing Informational (4 items)
- Writing Prompt-Narrative (4 items)

P+ and Adjusted P+ varied slightly across all domains. The Reading at Word Level Domain and Reading Informational Text Domain have the lowest P+ and Adjusted P+ values, both with a P+ of $19 \%$ and an Adjusted $\mathrm{P}+$ of $31 \%$. The Reading Literature Domain has a P+ at $22 \%$ and Adjusted $\mathrm{P}+$ at $35 \%$. The Writing Informational Domain has a $\mathrm{P}+$ at $24 \%$ and Adjusted $\mathrm{P}+$ at $41 \%$. The Writing Prompt-Narrative Domain has a $\mathrm{P}+$ of $23 \%$ and Adjusted $\mathrm{P}+$ at $45 \%$. The total mean $\mathrm{P}+$ for all 61 items is $21 \%$ and the Adjusted $\mathrm{P}+$ is $34 \%$.

Grade 5 ELA - P+, Adjusted P+, and Domains (MC Items)

| Domain | $\mathbf{P}$ | Adjusted $\mathbf{P}_{+}$ | $\mathbf{N}$ |
| :--- | :---: | :---: | :---: |
| Reading at Word Level | 0.1925 | 0.3121 | 8 |
| Reading Informational Text | 0.1924 | 0.3096 | 21 |
| Reading Literature | 0.2208 | 0.3550 | 24 |
| Writing Informational | 0.2425 | 0.4051 | 4 |
| Writing Prompt-Narrative | 0.2250 | 0.4500 | 4 |
| Total | 0.2090 | 0.3432 | 61 |

Table 134. Grade 5 ELA P+ and Adjusted P+ by Domain


Figure 97. Grade 5 ELA P+ and Adjusted P+ by Domain.

## Item Difficulty by Domain and Tier

Grade 5 ELA P+ and Adjusted P+ were examined by domain and tier combined. We found the same general pattern of modestly decreasing values for the higher tiers, especially when using Adjusted $\mathrm{P}+\mathrm{P}+$ for the domains in Tier 1 was $27 \%$ ( 14 items), Tier 2 is $20 \%$ ( 12 items), and Tier 3 is $19 \%$ ( 27 items). We found a greater difference in the Adjusted $\mathrm{P}+$ for domains in each tier with $54 \%$ for Tier 1, 30\% for Tier 2 , and $29 \%$ for Tier 3 .

|  | RWL | RIT | RL | WI | WPN |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 2 | 3 | 4 | 1 | 4 |
| Tier 2 | 1 | 10 | 0 | 1 | 0 |
| Tier 3 | 4 | 8 | 14 | 1 | 0 |
| Tier 4 | 1 | 0 | 6 | 1 | 0 |

Table 135. Grade 5 ELA Items by Domain and Tier

Grade 5 ELA - P+, Adjusted P+ of domain by tier (MC Items)

| Tier | Domain | P+ | Adjusted $\mathrm{P}_{+}$ | N |
| :---: | :---: | :---: | :---: | :---: |
| Tier 1 | Reading at Word Level | 0.1950 | 0.3900 | 2 |
|  | Reading Informational Text | 0.3100 | 0.6200 | 3 |
|  | Reading Literature | 0.3000 | 0.6000 | 4 |
|  | Writing Informational | 0.3400 | 0.6800 | 1 |
|  | Writing Prompt-Narrative | 0.2250 | 0.4500 | 4 |
|  | Total | 0.2686 | 0.5371 | 14 |
| Tier 2 | Reading at Word Level | 0.1800 | 0.2687 | 1 |
|  | Reading Informational Text | 0.1850 | 0.2761 | 10 |
|  | Writing Informational | 0.3900 | 0.5821 | 1 |
|  | Total | 0.2017 | 0.3010 | 12 |
| Tier 3 | Reading at Word Level | 0.2375 | 0.3545 | 4 |
|  | Reading Informational Text | 0.1575 | 0.2351 | 8 |
|  | Reading Literature | 0.2107 | 0.3145 | 14 |
|  | Writing Informational | 0.1100 | 0.1642 | 1 |
|  | Total | 0.1952 | 0.2913 | 27 |
| Tier 4 | Reading at Word Level | 0.0200 | 0.0299 | 1 |
|  | Reading Literature | 0.1917 | 0.2861 | 6 |
|  | Writing Informational | 0.1300 | 0.1940 | 1 |
|  | Total | 0.1625 | 0.2425 | 8 |
| Total | Reading at Word Level | 0.1925 | 0.3121 | 8 |
|  | Reading Informational Text | 0.1924 | 0.3096 | 21 |
|  | Reading Literature | 0.2208 | 0.3550 | 24 |
|  | Writing Informational | 0.2425 | 0.4051 | 4 |
|  | Writing Prompt-Narrative | 0.2250 | 0.4500 | 4 |
|  | Total | 0.2090 | 0.3432 | 61 |

Table 136. Grade 5 ELA P+ and Adjusted P+ by Domain and Tier

|  | ELA, Grade 5, P+ |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Writing Prompt-Narrative | $0.22$ <br> (4) |  |  |  |
| Writing Informational | $0.34$ <br> (1) | $0.39$ <br> (1) | $0.11$ <br> (1) | $0.13$ <br> (1) |
| Reading Literature | 0.3 <br> (4) |  | $0.21$ <br> (14) | 0.19 <br> (6) |
| Reading Informational Text | $\begin{gathered} 0.31 \\ (3) \end{gathered}$ | $\begin{aligned} & 0.18 \\ & (10) \end{aligned}$ | $\begin{gathered} 0.16 \\ (8) \end{gathered}$ |  |
| Reading at Word Level | $\begin{aligned} & 0.2 \\ & (2) \end{aligned}$ | $\begin{gathered} 0.18 \\ (1) \end{gathered}$ | $0.24$ <br> (4) | $\begin{gathered} 0.02 \\ (1) \end{gathered}$ |
|  | 1 | 2 | 3 | 4 |

Figure 98. Grade 5 ELA Heat Map of P+ by Domain and Tier


Figure 99. Grade 5 ELA Heat Map of Adjusted P+ by Domain and Tier

## Grade 8 ELA

## Item Difficulty by Tier

A total of 85 multiple choice items were analyzed to determine the $\mathrm{P}+$ values and the Adjusted $\mathrm{P}+$ values at each tier. The mean P+ and Adjusted P+ values varied slightly across all tiers, with the greatest difference between Tier 1 and Tier 4. Values were highest for Tier 1, with a P+ of $26 \%$ and an Adjusted P+ of $51 \%$ for the 23 items. There are 23 items in Tier 2 with a P+ of $29 \%$ and an Adjusted $\mathrm{P}+$ of $44 \%$. $\mathrm{P}+$ for Tier 3 is $20 \%$ and the Adjusted $\mathrm{P}+$ is $30 \%$ for the 28 items. Tier 4 has the least number of items and the lowest values for $\mathrm{P}+, 12 \%$, and Adjusted $\mathrm{P}+18 \%$.

## Grade 8 ELA - P+, Adjusted P+ and Tiers (MC Items)

| Tier | $\mathbf{P}$ | Adjusted <br> $\mathbf{P}+$ | $\mathbf{N}$ |
| :--- | :---: | :---: | :---: |
| Tier 1 | 0.2565 | 0.5130 | 23 |
| Tier 2 | 0.2948 | 0.4400 | 23 |
| Tier 3 | 0.1996 | 0.2980 | 28 |
| Tier 4 | 0.1218 | 0.1818 | 11 |
| Total | 0.2307 | 0.3796 | 85 |

Table 137. Grade 8 ELA P+ and Adjusted P+ by Tier


Figure 100. Grade 8 ELA P+ and Adjusted P+ by Tier
Item Difficulty by Domain
$\mathrm{P}+$ and Adjusted $\mathrm{P}+$ values for the following ELA domains were examined:

- Reading at Word Level (11 items)
- Reading Informational Text (41 items)
- Reading Literature (23 items)
- Writing Prompt-Expository (6 items)
- Writing Prompt-Persuasive 48 items)
$\mathrm{P}+$ and Adjusted $\mathrm{P}+$ values varied minimally across all domains. The Reading Literature Domain has the highest P+ and Adjusted P+ at $29 \%$ and $46 \%$, respectively, for the 23 multiple choice items. The Writing Prompt-Persuasive Domain has the next highest values with a P+ of $27 \%$ and an Adjusted $\mathrm{P}+$ of $45 \%$. The Reading at Word Level Domain has a P+ of $24 \%$ and an Adjusted P+ of $39 \%$ for the 11 items. The Reading Informational Text Domain has the lowest values with a P+ of $19 \%$ and Adjusted P+ of $32 \%$. The Writing Prompt-Expository Domain has 6 items with a P+ of $23 \%$ and an Adjusted $\mathrm{P}+$ of $45 \%$. The total $\mathrm{P}+$ for all domains is $23 \%$ and the Adjusted $\mathrm{P}+$ value is $38 \%$.

Grade 8 ELA - P+, Adjusted P+, and Domains (MC Items)

| Domain | P+ | Adjusted P+ | $\mathbf{N}$ |
| :--- | :---: | :---: | :---: |
| Reading at Word Level | 0.2355 | 0.3911 | 11 |
| Reading Informational Text | 0.1932 | 0.3154 | 41 |
| Reading Literature | 0.2896 | 0.4567 | 23 |
| Writing Prompt-Expository | 0.2267 | 0.4533 | 6 |
| Writing Prompt-Persuasive | 0.2700 | 0.4512 | 4 |
| Total | 0.2307 | 0.3796 | 85 |



Figure 101. Grade 8 ELA P+ and Adjusted P+ by Domain
Item Difficulty by Domain and Tier
Next, we analyzed the 85 items in grade 8 ELA by domain and tier combined. We note the P+ and Adjusted $\mathrm{P}+$ values for the domains in Tier 4 are lower than the other tiers across most all domains. We also observe a general pattern where Tier 3 and Tier 4 items tend to be modestly more difficult than Tier 1 and Tier 2 items, especially when using the Adjusted $\mathrm{P}+$ metric.

|  | RWL | RIT | RL | WPE | WPP |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 3 | 10 | 3 | 6 | 1 |
| Tier 2 | 3 | 9 | 10 | 0 | 1 |
| Tier 3 | 4 | 13 | 10 | 0 | 1 |
| Tier 4 | 1 | 9 | 0 | 0 | 1 |

[^11]Grade 8 ELA - P+, Adjusted P+ of domain by tier (MC Items)

| Tier | Domain | P+ | Adjusted P+ | N |
| :---: | :---: | :---: | :---: | :---: |
| Tier 1 | Reading at Word Level | . 2867 | . 5733 | 3 |
|  | Reading Informational Text | . 2190 | . 4380 | 10 |
|  | Reading Literature | . 3700 | . 7400 | 3 |
|  | Writing Prompt-Expository | . 2267 | . 4533 | 6 |
|  | Writing Prompt-Persuasive | . 3800 | . 7600 | 1 |
|  | Total | . 2565 | . 5130 | 23 |
| Tier 2 | Reading at Word Level | . 3000 | . 4478 | 3 |
|  | Reading Informational Text | . 2378 | . 3549 | 9 |
|  | Reading Literature | . 3520 | . 5254 | 10 |
|  | Writing Prompt-Persuasive | . 2200 | . 3284 | 1 |
|  | Total | . 2948 | . 4400 | 23 |
| Tier 3 | Reading at Word Level | . 1975 | . 2948 | 4 |
|  | Reading Informational Text | . 1854 | . 2767 | 13 |
|  | Reading Literature | . 2030 | . 3030 | 10 |
|  | Writing Prompt-Persuasive | . 3600 | . 5373 | 1 |
|  | Total | . 1996 | . 2980 | 28 |
| Tier 4 | Reading at Word Level | . 0400 | . 0597 | 1 |
|  | Reading Informational Text | . 1311 | . 1957 | 9 |
|  | Writing Prompt-Persuasive | . 1200 | . 1791 | 1 |
|  | Total | . 1218 | . 1818 | 11 |
| Total | Reading at Word Level | . 2355 | . 3911 | 11 |
|  | Reading Informational Text | . 1932 | . 3154 | 41 |
|  | Reading Literature | . 2896 | . 4567 | 23 |
|  | Writing Prompt-Expository | . 2267 | . 4533 | 6 |
|  | Writing Prompt-Persuasive | . 2700 | . 4512 | 4 |
|  | Total | . 2307 | . 3796 | 85 |

Table 140. Grade 8 ELA P+ and Adjusted P+ by Tier and Domain


Figure 102. Grade 8 ELA Heat Map of P+ by Tier and Domain


Figure 103. Grade 8 ELA Heat Map of Adjusted P+ by Tier and Domain

## Grade 11 ELA

## Item Difficulty by Tier

A total of 55 multiple choice items were analyzed to determine the mean $\mathrm{P}+$ and the Adjusted $\mathrm{P}+$ values at each tier. We found $\mathrm{P}+$ varied slightly across all tiers with a more significant variation in the Adjusted P+ values, with the greatest difference between Tier 1 and Tier 4. Items are easiest for Tier 1 for the Adjusted $\mathrm{P}+$ value; whereas the items show to be slightly easier at Tier 2 based on $\mathrm{P}+$. There are 19 items for Tier 1 with a $\mathrm{P}+$ of $29 \%$ and an Adjusted $\mathrm{P}+$ of $57 \%$. There are 11 items in Tier 2 with a P+ of $33 \%$ and an Adjusted $\mathrm{P}+$ of $50 \%$. The $\mathrm{P}+$ value for Tier 3 is $21 \%$ and the Adjusted $\mathrm{P}+$ is $31 \%$ for the 16 items. Tier 4 has the least number of items and the lowest values; $\mathrm{P}+$ for this tier is $18 \%$ and the Adjusted $\mathrm{P}+$ is $27 \%$. The total $\mathrm{P}+$ for all 55 items is $25 \%$ and the Adjusted $\mathrm{P}+$ is $43 \%$.

Grade 11 ELA - P+, Adjusted P+ and Tiers (MC Items)

| Tier | $\mathbf{P}$ | Adjusted $\mathbf{P +}$ | $\mathbf{N}$ |
| :--- | :---: | :---: | :---: |
| Tier 1 | .2858 | .5716 | 19 |
| Tier 2 | .3336 | .4980 | 11 |
| Tier 3 | .2081 | .3106 | 16 |
| Tier 4 | .1789 | .2670 | 9 |
| Total | .2553 | .4311 | 55 |

Table 141. Grade 11 ELA P+ and Adjusted P+ by Tier


Figure 104. Grade 11 ELA P+ and Adjusted P+ by Tier

## Item Difficulty by Domain

A total of 55 multiple choice items were analyzed to determine the $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ values for each of the four domains, which include:

- Reading at Word Level (8 items)
- Reading Informational Text (19 items)
- Reading Literature (19 items)
- Writing Informational (3 items)
- Writing Prompt-Argument (6 items)

The $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ values varied slightly across all domains. The Reading Informational Text Domain has the lowest P+ at 20\% and Adjusted P+ at 36\% for the 19 items. The Reading at Word Level Domain has a P+ of $31 \%$ and an Adjusted $\mathrm{P}+$ of $50 \%$. The Reading Literature Domain has a $\mathrm{P}+$ of $28 \%$ and an Adjusted P+ of $45 \%$ for the 19 items. The Writing Informational Domain has a total of 3 items with a P+ of $25 \%$ and Adjusted $\mathrm{P}+$ of $40 \%$. The Writing Prompt-Argument has a P+ of $25 \%$ and an Adjusted $\mathrm{P}+$ of $51 \%$. The total mean $\mathrm{P}+$ for all domains is $25 \%$ and the Adjusted $\mathrm{P}+$ is $43 \%$.

Grade 11 ELA - P+, Adjusted P+, and Domains (MC Items)

| Domain | P+ | Adjusted P+ | N |
| :--- | :---: | :---: | :---: |
| Reading at Word Level | .3113 | .5045 | 8 |
| Reading Informational Text | .2042 | .3601 | 19 |
| Reading Literature | .2847 | .4520 | 19 |
| Writing Informational | .2467 | .4020 | 3 |
| Writing Prompt-Argument | .2533 | .5067 | 6 |
| Total | .2553 | .4311 | 55 |

Table 142. Grade 11 ELA P+ and Adjusted P+ by Domain


Figure 105. Grade 11 ELA P+ and Adjusted P+ by Domain
Item Difficulty by Domain and Tier
We examined grade 11 ELA P+ and Adjusted P+ by domain and tier to evaluate difficulty. We note items are generally more difficult based on both $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ for Tiers 3 and 4 compared to Tiers 1 and 2 across all domains. This finding appears to be more pronounced for Adjusted $\mathrm{P}+$ compared to $\mathrm{P}+$.

|  | RWL | RIT | RL | WI | WP-A |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 2 | 7 | 3 | 1 | 6 |
| Tier 2 | 2 | 0 | 8 | 1 | 0 |
| Tier 3 | 3 | 5 | 8 | 0 | 0 |
| Tier 4 | 1 | 7 | 0 | 1 | 0 |

Grade 11 ELA - P+, Adjusted P+ of domain by tier (MC Items)

|  |  |  |  |  |
| :--- | :--- | :---: | :---: | :---: |
|  | Tier | Pomain | P+ | Adjusted P+ | N

Table 144. Grade 11 ELA P+ and Adjusted P+ by Tier and Domain

|  | ELA, Grade 11, P+ |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Writing Prompt-Argument | $0.25$ <br> (6) |  |  |  |
| Writing Informational | 0.2 <br> (1) | $\begin{gathered} 0.39 \\ (1) \end{gathered}$ |  | $0.15$ <br> (1) |
| Reading Literature | $0.34$ <br> (3) | $0.32$ <br> (8) | $0.24$ <br> (8) |  |
| Reading Informational Text | 0.3 <br> (7) |  | $\begin{gathered} 0.13 \\ (5) \end{gathered}$ | $\begin{gathered} 0.17 \\ (7) \end{gathered}$ |
| Reading at Word Level | $\begin{gathered} 0.32 \\ (2) \end{gathered}$ | $\begin{gathered} 0.38 \\ (2) \end{gathered}$ | $\begin{gathered} 0.27 \\ (3) \end{gathered}$ | $\begin{gathered} 0.28 \\ (1) \end{gathered}$ |
|  | 1 | 2 | 3 | 4 |

Figure 106. Grade 11 ELA Heat Map of P+ by Tier and Domain


Figure 107. Grade 11 ELA Heat Map of P+ and Adjusted P+ by Tier and Domain

## Grade 3 Math

## Item Difficulty by Tier

We analyzed item difficulty for grade 3 math using $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ for a total of 73 multiple choice items. Results show that P+ and Adjusted P+ varied slightly across Tiers 1, 2, and 3, with a greater difference for Tier 4. Difficulty was lowest for Tier 1, with a P+ of $18 \%$ and an Adjusted P+ of $37 \%$ for the 16 items. Tier 4 items were most difficult. $\mathrm{P}+$ for this tier is $7 \%$ and the Adjusted $\mathrm{P}+\mathrm{is} 11 \%$. There are 26 items in Tier 2 with a $\mathrm{P}+$ of $18 \%$ and an Adjusted $\mathrm{P}+\mathrm{e}$ of $27 \%$ and 22 items in Tier 3 with a $\mathrm{P}+$ of $14 \%$ and an Adjusted $\mathrm{P}+$ of $21 \%$. The total mean $\mathrm{P}+$ for all 73 items is $15 \%$ and $25 \%$ for the Adjusted $\mathrm{P}+$.

## Grade 3 Math - P+, Adjusted P+ and Tiers (MC Items)

| Tier | $\mathbf{P}$ | Adjusted $\mathbf{P +}$ | $\mathbf{N}$ |
| :--- | :---: | :---: | :---: |
| Tier 1 | 0.1844 | 0.3688 | 16 |
| Tier 2 | 0.1796 | 0.2681 | 26 |
| Tier 3 | 0.1377 | 0.2056 | 22 |
| Tier 4 | 0.0733 | 0.1095 | 9 |
| Total | 0.1549 | 0.2517 | 73 |

Table 145. Grade 3 Math P+ and Adjusted P+ by Tier


Figure 108. Grade 3 Math P+ and Adjusted P+ by Tier

## Item Difficulty by Domain

A total of 73 multiple choice items were analyzed to determine the mean $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ values for each of the five domains, which include:

- Geometry ( 10 items)
- Measurement and Data (9 items)
- Number and Operations Base Ten (15 items)
- Number and Operations Fractions (16 items)
- Operations and Algebraic Thinking (23 items)

P+ and Adjusted P+ varied minimally across all domains except the Geometry Domain which had the highest $\mathrm{P}+(25 \%)$ as well as the highest Adjusted $\mathrm{P}+(40 \%)$. The Number and Operations Fractions Domain had the lowest $\mathrm{P}+$ at $11 \%$ and Adjusted $\mathrm{P}+$ at $18 \%$. The Measurement and Data Domain had a $\mathrm{P}+$ at $17 \%$ and Adjusted P+ at $28 \%$. Number and Operations Base Ten Domain had a P+ at $14 \%$ and Adjusted $\mathrm{P}+$ at $22 \%$, and Operations and Algebraic Thinking Domain had a $\mathrm{P}+$ at $15 \%$ and Adjusted $\mathrm{P}+$ at $24 \%$. The total mean $\mathrm{P}+$ for all 73 items is $15 \%$ and the Adjusted $\mathrm{P}+$ is $25 \%$.

## Grade 3 Math - P+, Adjusted P+, and Domains (MC Items)

| Domain | $\mathbf{P +}$ | Adjusted P+ | $\mathbf{N}$ |
| :--- | :---: | :---: | :---: |
| Geometry | 0.2530 | 0.4020 | 10 |
| Measurement and Data | 0.1689 | 0.2814 | 9 |
| Number and Operations Base Ten | 0.1360 | 0.2250 | 15 |
| Number and Operations Fractions | 0.1063 | 0.1792 | 16 |
| Operations and Algebraic Thinking | 0.1530 | 0.2428 | 23 |
| Total | 0.1549 | 0.2517 | 73 |

Table 146. Grade 3 Math P+ and Adjusted P+ by Domain


Figure 109. Grade 3 Math P+ and Adjusted P+ by Domain

## Item Difficulty by Tier and Domain

Next, we examined grade 3 math $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ values by tier and domain. Overall, we found a pattern of generally increasing difficulty by tier, which was more prominently observed with Adjusted $\mathrm{P}+$ compared to $\mathrm{P}+$. This pattern was evident for most all domains, even as domain difficulty varied. In particular, we found that Tier 4 items were generally distinct from other tiers with respect to item difficulty using $\mathrm{P}+$ and especially Adjusted $\mathrm{P}+$.

|  | G | MD | NOBT | NOF | OAT |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 2 | 3 | 4 | 3 | 4 |
| Tier 2 | 3 | 3 | 3 | 8 | 9 |
| Tier 3 | 4 | 2 | 6 | 3 | 7 |
| Tier 4 | 1 | 1 | 2 | 2 | 3 |

## Grade 3 Math - P+, Adjusted P+ of domain by tier (MC Items)

| Tier | Domain | P+ | Adjusted P+ | N |
| :---: | :---: | :---: | :---: | :---: |
| Tier 1 | Geometry | 0.2400 | 0.4800 | 2 |
|  | Measurement and Data | 0.1733 | 0.3467 | 3 |
|  | Number and Operations Base Ten | 0.1625 | 0.3250 | 4 |
|  | Number and Operations Fractions | 0.2167 | 0.4333 | 3 |
|  | Operations and Algebraic Thinking | 0.1625 | 0.3250 | 4 |
|  | Total | 0.1844 | 0.3688 | 16 |
| Tier 2 | Geometry | 0.2667 | 0.3980 | 3 |
|  | Measurement and Data | 0.2100 | 0.3134 | 3 |
|  | Number and Operations Base Ten | 0.1167 | 0.1741 | 3 |
|  | Number and Operations Fractions | 0.0863 | 0.1287 | 8 |
|  | Operations and Algebraic Thinking | 0.2444 | 0.3648 | 9 |
|  | Total | 0.1796 | 0.2681 | 26 |
| Tier 3 | Geometry | 0.2475 | 0.3694 | 4 |
|  | Measurement and Data | 0.1650 | 0.2463 | 2 |
|  | Number and Operations Base Ten | 0.1433 | 0.2139 | 6 |
|  | Number and Operations Fractions | 0.0800 | 0.1194 | 3 |
|  | Operations and Algebraic Thinking | 0.0871 | 0.1301 | 7 |
|  | Total | 0.1377 | 0.2056 | 22 |
| Tier 4 | Geometry | 0.2600 | 0.3881 | 1 |
|  | Measurement and Data | 0.0400 | 0.0597 | 1 |
|  | Number and Operations Base Ten | 0.0900 | 0.1343 | 2 |
|  | Number and Operations Fractions | 0.0600 | 0.0896 | 2 |
|  | Operations and Algebraic Thinking | 0.0200 | 0.0299 | 3 |
|  | Total | 0.0733 | 0.1095 | 9 |
| Total | Geometry | 0.2530 | 0.4020 | 10 |
|  | Measurement and Data | 0.1689 | 0.2814 | 9 |
|  | Number and Operations Base Ten | 0.1360 | 0.2250 | 15 |
|  | Number and Operations Fractions | 0.1063 | 0.1792 | 15 |
|  | Operations and Algebraic Thinking | 0.1530 | 0.2428 | 23 |
|  | Total | 0.1549 | 0.2517 | 72 |

Table 148. Grade 3 Math P+ and Adjusted P+ by Tier and Domain


Figure 110. Grade 3 Math Heat Map P+ by Tier and Domain


Figure 111. Grade 3 Math Heat Map Adjusted P+ by Tier and Domain

## Grade 5 Math

## Item Difficulty by Tier

$\mathrm{P}+$ and Adjusted $\mathrm{P}+$ were examined for 77 multiple choice items in grade 5 math to evaluate item difficulty by tier. We found $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ varied across all tiers, with a greater difference between the lower tiers (Tier 1 and Tier 2) compared to the higher tiers (Tier 3 and Tier 4). $\mathrm{P}+$ was highest for Tier 1 at $19 \%$ and Adjusted $\mathrm{P}+$ was $38 \%$ for these items. $\mathrm{P}+$ is $13 \%$ for Tier 2 and Adjusted $\mathrm{P}+$ is $19 \%$ for this tier. The $\mathrm{P}+$ for Tier 3 is $7 \%$ and the Adjusted $\mathrm{P}+$ is $10 \%$. Finally, Tier 4 was the most difficult with $\mathrm{P}+$ at $8 \%$ and Adjusted $\mathrm{P}+$ at $2 \%$. The total mean $\mathrm{P}+$ for all items is $12 \%$ and $19 \%$ for Adjusted $\mathrm{P}+$.

## Grade 5 Math - P+, Adjusted P+ and Tiers (MC

 Items)| Tier | $\mathbf{P}$ | Adjusted <br> $\mathbf{P}+$ | $\mathbf{N}$ |
| :--- | :---: | :---: | :---: |
| Tier 1 | 0.1876 | 0.3753 | 17 |
| Tier 2 | 0.1286 | 0.1919 | 28 |
| Tier 3 | 0.0656 | 0.0979 | 25 |
| Tier 4 | 0.0800 | 0.1194 | 7 |
| Total | 0.1168 | 0.1953 | 77 |

Table 149. Grade 5 Math P+ and Adjusted P+ by Tier


Figure 112. Grade 5 Math P+ and Adjusted P+ by Tier

## Item Difficulty by Domain

A total of 77 multiple choice items were analyzed to determine the $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ for each of the five domains, which include:

- Geometry (5 items)
- Measurement and Data (16 items)
- Number and Operations Base Ten (33 items)
- Number and Operations Fractions (16 items)
- Operations and Algebraic Thinking (7 items)

We found difficulty varied minimally across all domains. The Geometry Domain had a P+ of $14 \%$ and an Adjusted P+ of $22 \%$. Geometry Domain was similar to values in the Number and Operations Domain which had a P+ of $13 \%$ and an Adjusted $\mathrm{P}+$ of $23 \%$. The Number and Operations Fractions Domain had a $\mathrm{P}+$ at $11 \%$ and Adjusted $\mathrm{P}+$ at $18 \%$. The Measurement and Data Domain had a P+ at $9 \%$ and Adjusted $\mathrm{P}+$ at $16 \%$. Operations and Algebraic Thinking Domain had the lowest $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ values at $8 \%$ and $14 \%$, respectively. The total mean $\mathrm{P}+$ for all 77 items is $12 \%$ and the Adjusted $\mathrm{P}+$ value is $19 \%$.

Grade 5 Math - P+, Adjusted P+, and Domains (MC Items)

| Domain | P+ | Adjusted P+ | N |
| :---: | :---: | :---: | :---: |
| Geometry | 0.1380 | 0.2242 | 5 |
| Measurement and Data | 0.0950 | 0.1649 | 16 |
| Number and Operations Base Ten | 0.1339 | 0.2253 | 33 |
| Number and Operations Fractions | 0.1119 | 0.1806 | 16 |
| Operations and Algebraic Thinking | 0.0814 | 0.1360 | 7 |
| Total | 0.1168 | 0.1953 | 77 |

Table 150. Grade 5 Math P+ and Adjusted P+ by Domain


Figure 113. Grade 5 Math P+ and Adjusted P+ by Domain

## Item Difficulty by Tier and Domain

A clear pattern did not emerge from our analyses of difficulty using $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ by tier and domain. While most Tier 2-4 items were more difficult than Tier 1 based on $\mathrm{P}+$ and Adjusted $\mathrm{P}+$, differences among Tiers 2-4 were minimal. In many cases, Tier 3 items were the most difficult, which is a pattern observed across several domains for grade 5 math.

|  | G | MD | NOBT | NOF | OAT |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 1 | 4 | 7 | 4 | 1 |
| Tier 2 | 4 | 6 | 10 | 7 | 1 |
| Tier 3 | 0 | 5 | 12 | 4 | 4 |
| Tier 4 | 0 | 1 | 4 | 1 | 1 |

Table 151. Grade 5 Math Items by Tier and Domain

Grade 5 Math - P+, Adjusted P+ of domain by tier (MC Items)

| Tier | Domain | P+ | Adjusted P+ | N |
| :---: | :---: | :---: | :---: | :---: |
| Tier 1 | Geometry | 0.1800 | 0.3600 | 1 |
|  | Measurement and Data | 0.1825 | 0.3650 | 4 |
|  | Number and Operations Base Ten | 0.2357 | 0.4714 | 7 |
|  | Number and Operations Fractions | 0.1075 | 0.2150 | 4 |
|  | Operations and Algebraic Thinking | 0.2000 | 0.4000 | 1 |
|  | Total | 0.1876 | 0.3753 | 17 |
| Tier 2 | Geometry | 0.1275 | 0.1903 | 4 |
|  | Measurement and Data | 0.0717 | 0.1070 | 6 |
|  | Number and Operations Base Ten | 0.1580 | 0.2358 | 10 |
|  | Number and Operations Fractions | 0.1257 | 0.1876 | 7 |
|  | Operations and Algebraic Thinking | 0.2000 | 0.2985 | 1 |
|  | Total | 0.1286 | 0.1919 | 28 |
| Tier 3 | Measurement and Data | 0.0640 | 0.0955 | 5 |
|  | Number and Operations Base Ten | 0.0675 | 0.1007 | 12 |
|  | Number and Operations Fractions | 0.0850 | 0.1269 | 4 |
|  | Operations and Algebraic Thinking | 0.0425 | 0.0634 | 4 |
|  | Total | 0.0656 | 0.0979 | 25 |
| Tier 4 | Measurement and Data | 0.0400 | 0.0597 | 1 |
|  | Number and Operations Base Ten | 0.0950 | 0.1418 | 4 |
|  | Number and Operations Fractions | 0.1400 | 0.2090 | 1 |
|  | Operations and Algebraic Thinking | 0.0000 | 0.0000 | 1 |
|  | Total | 0.0800 | 0.1194 | 7 |
| Total | Geometry | 0.1380 | 0.2242 | 5 |
|  | Measurement and Data | 0.0950 | 0.1649 | 16 |
|  | Number and Operations Base Ten | 0.1339 | 0.2253 | 33 |
|  | Number and Operations Fractions | 0.1119 | 0.1806 | 16 |
|  | Operations and Algebraic Thinking | 0.0814 | 0.1360 | 7 |
|  | Total | 0.1168 | 0.1953 | 77 |

Table 152. Grade 5 Math P+ and Adjusted P+ by Tier and Domain


Figure 114. Grade 5 Math Heat Map of P+ by Tier and Domain


Figure 115. Grade 5 Math Heat Map of Adjusted P+ by Tier and Domain

## Grade 8 Math

## Item Difficulty by Tier

A total of 76 multiple choice items were analyzed to determine the $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ at each tier. We found the $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ values varied slightly across all tiers, with the greatest difference between Tier 1 and Tier 4. The highest values were associated with Tier 1 with a $\mathrm{P}+$ value of $18 \%$ and an Adjusted $\mathrm{P}+$ value of $36 \%$ for the 16 items. There are 27 items in Tier 2 with a $\mathrm{P}+$ of $17 \%$ and an Adjusted $\mathrm{P}+$ of $25 \%$. The $\mathrm{P}+$ for Tier 3 is $12 \%$ and the Adjusted $\mathrm{P}+$ is $17 \%$ for the 28 items. Tier 4 has the least number of items (5) and the lowest values; the $\mathrm{P}+$ for this tier is $8 \%$ and the Adjusted $\mathrm{P}+$ value is $12 \%$. The total mean $\mathrm{P}+$ for all 76 items is $14 \%$ and $24 \%$ for the Adjusted $\mathrm{P}+$.

## Grade 8 Math - P+, Adjusted P+ and Tiers (MC Items)

| Tier | $\mathbf{P}$ | Adjusted <br> $\mathbf{P}+$ | $\mathbf{N}$ |
| :--- | :---: | :---: | :---: |
| Tier 1 | 0.1788 | 0.3575 | 16 |
| Tier 2 | 0.1667 | 0.2488 | 27 |
| Tier 3 | 0.1168 | 0.1743 | 28 |
| Tier 4 | 0.0800 | 0.1194 | 5 |
| Total | 0.1451 | 0.2357 | 76 |

Table 153. Grade 8 Math P+ and Adjusted P+ by Tier


Figure 116. Grade 8 Math P+ and Adjusted P+ by Tier

## Item Difficulty by Domain

A total of 76 multiple choice items were analyzed to determine the $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ for each of the five domains, which include:

- Expressions and Equations (14 items)
- Functions (16 items)
- Geometry (24 items)
- Statistics and Probability ( 14 items)
- The Number System (8 items)

We found $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ values varied slightly across all domains. The Geometry Domain had the highest $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ at $19 \%$ and $30 \%$, respectively, for the 24 multiple choice items in this domain. Statistics and Probability Domain had the next highest values for the 14 items in this domain with a P+ of $15 \%$ and an Adjusted P+ of $25 \%$. The Number System Domain had a P+ of $14 \%$ and an Adjusted P+ of $24 \%$ for the 8 items. The Functions Domain had a total of 16 multiple choice items with a P+ of $13 \%$ and Adjusted $\mathrm{P}+$ of $21 \%$. The Expressions and Equations Domain ( 14 items ) was most difficult with a $9 \% \mathrm{P}+$ value and a $14 \%$ Adjusted $\mathrm{P}+$ value. The mean total $\mathrm{P}+$ for all domains is $14 \%$ and Adjusted $\mathrm{P}+$ is $24 \%$.

## Grade 8 Math - P+, Adjusted P+, and Domains (MC Items)

| Domain | P+ | Adjusted P+ | N |
| :---: | :---: | :---: | :---: |
| Expressions and Equations | 0.0893 | 0.1369 | 14 |
| Functions | 0.1313 | 0.2140 | 16 |
| Geometry | 0.1875 | 0.2999 | 24 |
| Statistics and Probability | 0.1486 | 0.2460 | 14 |
| The Number System | 0.1375 | 0.2414 | 8 |
| Total | 0.1451 | 0.2357 | 76 |



Figure 117. Grade 8 Math P+ and Adjusted P+ by Domain

## Item Difficulty by Tier and Domain

No strong and consistent patterns were observed when analyzing P+ and Adjusted P+ by tier and domain for grade 8 math. We note a general ordering of increasing difficulty by tier for Geometry and Number System domains. However, this pattern was not evident for the Functions and Expressions and Equations domains. In fact, a pattern of decreasing difficulty for higher tiers was observed for Expressions and Equations using P+ and Adjusted P+. As is the case with other grade and content tests explored, the limited number of Tier 4 items (typically one per cell) suggests caution in generalizing from these findings.

|  | EE | F | G | SP | TNS |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Tier 1 | 2 | 4 | 4 | 4 | 2 |
| Tier 2 | 5 | 5 | 9 | 6 | 2 |
| Tier 3 | 6 | 6 | 10 | 3 | 3 |
| Tier 4 | 1 | 1 | 1 | 1 | 1 |

Grade 8 Math - P+, Adjusted P+ of domain by tier (MC Items)

| Tier | Domain | P+ | Adjusted P+ | N |
| :---: | :---: | :---: | :---: | :---: |
| Tier 1 | Expressions and Equations | . 0500 | . 1000 | 2 |
|  | Functions | . 1425 | . 2850 | 4 |
|  | Geometry | . 2375 | . 4750 | 4 |
|  | Statistics and Probability | . 1675 | . 3350 | 4 |
|  | The Number System | . 2850 | . 5700 | 2 |
|  | Total | . 1788 | . 3575 | 16 |
| Tier 2 | Expressions and Equations | . 0780 | . 1164 | 5 |
|  | Functions | . 1920 | . 2866 | 5 |
|  | Geometry | . 2222 | . 3317 | 9 |
|  | Statistics and Probability | . 1617 | . 2413 | 6 |
|  | The Number System | . 0900 | . 1343 | 2 |
|  | Total | . 1667 | . 2488 | 27 |
| Tier 3 | Expressions and Equations | . 1067 | . 1592 | 6 |
|  | Functions | . 0700 | . 1045 | 6 |
|  | Geometry | . 1460 | . 2179 | 10 |
|  | Statistics and Probability | . 1467 | . 2189 | 3 |
|  | The Number System | . 1033 | . 1542 | 3 |
|  | Total | . 1168 | . 1743 | 28 |
| Tier 4 | Expressions and Equations | . 1200 | . 1791 | 1 |
|  | Functions | . 1500 | . 2239 | 1 |
|  | Geometry | . 0900 | . 1343 | 1 |
|  | Statistics and Probability | . 0000 | . 0000 | 1 |
|  | The Number System | . 0400 | . 0597 | 1 |
|  | Total | . 0800 | . 1194 | 5 |
| Total | Expressions and Equations | . 0893 | . 1369 | 14 |
|  | Functions | . 1313 | . 2140 | 16 |
|  | Geometry | . 1875 | . 2999 | 24 |
|  | Statistics and Probability | . 1486 | . 2460 | 14 |
|  | The Number System | . 1375 | . 2414 | 8 |
|  | Total | . 1451 | . 2357 | 76 |

Table 156. Grade 8 Math P+ and Adjusted P+ by Tier and Domain

| The Number System | Math Grade 8, $\mathrm{P}+$ |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | $0.29$ <br> (2) | 0.09 <br> (2) | $0.1$ (3) | $0.04$ <br> (1) |
| Statistics and Probability | $0.17$ <br> (4) | 0.16 <br> (6) |  |  |
| Functions | $0.14$ <br> (4) | $0.19$ <br> (5) | $0.07$ <br> (6) | $0.15$ <br> (1) |
| Expressions and Equations | $\begin{gathered} 0.05 \\ (2) \end{gathered}$ | $\begin{gathered} 0.08 \\ (5) \end{gathered}$ | 0.11 <br> (6) | $0.12$ <br> (1) |
| Geometry | $0.24$ <br> (4) | $0.22$ <br> (9) | $\begin{aligned} & 0.15 \\ & (10) \end{aligned}$ | 0.09 <br> (1) |
|  | 1 | 2 | 3 | 4 |

Figure 118. Grade 8 Math Heat Map of P+ by Tier and Domain


Figure 119. Grade 8 Math Heat Map of Adjusted P+ by Tier and Domain

## Grade 11 Math

## Item Difficulty by Tier

A total of 75 multiple choice items were analyzed to determine the $\mathrm{P}+$ and the Adjusted $\mathrm{P}+$ at each tier. As with other grade and content areas we found marginal distinctions among tiers but general ordering of increasing difficulty for higher tiers. Tier 1 items were least difficult with a $\mathrm{P}+$ of $19 \%$ and an Adjusted $\mathrm{P}+$ of $38 \%$ for these 14 items. There are 30 items in Tier 2 with a P+ of $14 \%$ and an Adjusted $\mathrm{P}+$ of $21 \%$. The $\mathrm{P}+$ value for Tier 3 is $11 \%$ and the Adjusted $\mathrm{P}+$ is $16 \%$ for the 26 items. Tier 4 has the least number of items (5) and was most difficult. The $\mathrm{P}+$ for Tier 4 is $6 \%$ and the Adjusted $\mathrm{P}+$ is $9 \%$. The mean total $\mathrm{P}+$ for all 75 items is $13 \%$ and $21 \%$ for the Adjusted $\mathrm{P}+$.

Grade 11 Math - P+, Adjusted P+ and Tiers
(MC Items)

| Tier | $\mathbf{P}$ | Adjusted $\mathbf{P +}$ | $\mathbf{N}$ |
| :--- | :---: | :---: | :---: |
| Tier 1 | .1893 | .3786 | 14 |
| Tier 2 | .1377 | .2055 | 30 |
| Tier 3 | .1073 | .1602 | 26 |
| Tier 4 | .0580 | .0866 | 5 |
| Total | .1315 | .2141 | 75 |

Table 157. Grade 11 Math P+ and Adjusted P+ by Tier


Figure 120. Grade 11 Math P+ and Adjusted P+ by Tier

## Item Difficulty by Domain

A total of 75 multiple choice items were analyzed to determine the $\mathrm{P}+$ and Adjusted $\mathrm{P}+$ for each of the four domains, which include:

- Algebra and Functions (41 items)
- Geometry (8 items)
- Number and Quantity ( 16 items)
- Statistics and Probability (10 items)

We found the Geometry Domain had the lowest P+ and Adjusted P+ at 4\% and 7\%, respectively, for the 8 multiple choice items. The Algebra and Functions Domain had the highest values for the 41 items with a P+ of $16 \%$ and an Adjusted P+ of $26 \%$. The Statistics and Probability Domain had a P+ of $12 \%$ and an Adjusted P+ of $20 \%$ for the 10 items. The Number and Quantity Domain had a total of 16 multiple choice items with a $\mathrm{P}+$ of $11 \%$ and Adjusted $\mathrm{P}+$ of $18 \%$. The mean total $\mathrm{P}+$ for all domains is $13 \%$ and the Adjusted $\mathrm{P}+$ is $21 \%$.

## Grade 11 Math - P+, Adjusted P+, and Domains (MC Items)

| Domain | P+ | Adjusted P+ | N |
| :--- | :---: | :---: | :---: |
| Algebra And Functions | .1610 | .2614 | 41 |
| Geometry | .0438 | .0691 | 8 |
| Number and Quantity | .1081 | .1772 | 16 |
| Statistics and Probability | .1180 | .1954 | 10 |
| Total | .1315 | .2141 | 75 |

Table 158. Grade 11 Math P+ and Adjusted P+ by Domain


Figure 121. Grade 11 Math P+ and Adjusted P+ by Domain

Item Difficulty by Tier and Domain
For grade 11 math, we observe a general pattern of increasing item difficulty corresponding with higher tiers across all domains. This pattern is very modest for Geometry, where items are difficult for all tiers using both $\mathrm{P}+$ and Adjusted $\mathrm{P}+$. The pattern is more distinct for Number and Quantity and Algebra and Functions. In these domains, Tier 1 stands out as less difficult from the other tiers, especially using Adjusted P+. Otherwise, there are slight but ordered increases in difficulty associated with the upper tiers.

|  | AF | G | NQ | SP |
| :--- | :---: | :---: | :---: | :---: |
| Tier 1 | 8 | 1 | 3 | 2 |
| Tier 2 | 17 | 2 | 6 | 5 |
| Tier 3 | 14 | 4 | 6 | 2 |
| Tier 4 | 2 | 1 | 1 | 1 |

Table 159. Grade 11 Math Items by Tier and Domain

Grade 11 Math - P+, Adjusted P+of domain by tier (MC Items)

| Tier | Domain | P+ | Adjusted P+ | N |
| :---: | :---: | :---: | :---: | :---: |
| Tier 1 | Algebra And Functions | . 2138 | . 4275 | 8 |
|  | Geometry | . 0600 | . 1200 | 1 |
|  | Number and Quantity | . 1667 | . 3333 | 3 |
|  | Statistics and Probability | . 1900 | . 3800 | 2 |
|  | Total | . 1893 | . 3786 | 14 |
| Tier 2 | Algebra And Functions | . 1618 | . 2414 | 17 |
|  | Geometry | . 0450 | . 0672 | 2 |
|  | Number and Quantity | . 1250 | . 1866 | 6 |
|  | Statistics and Probability | . 1080 | . 1612 | 5 |
|  | Total | . 1377 | . 2055 | 30 |
| Tier 3 | Algebra And Functions | . 1364 | . 2036 | 14 |
|  | Geometry | . 0475 | . 0709 | 4 |
|  | Number and Quantity | . 0750 | . 1119 | 6 |
|  | Statistics and Probability | . 1200 | . 1791 | 2 |
|  | Total | . 1073 | . 1602 | 26 |
| Tier 4 | Algebra And Functions | . 1150 | . 1716 | 2 |
|  | Geometry | . 0100 | . 0149 | 1 |
|  | Number and Quantity | . 0300 | . 0448 | 1 |
|  | Statistics and Probability | . 0200 | . 0299 | 1 |
|  | Total | . 0580 | . 0866 | 5 |
| Total | Algebra And Functions | . 1610 | . 2614 | 41 |
|  | Geometry | . 0438 | . 0691 | 8 |
|  | Number and Quantity | . 1081 | . 1772 | 16 |
|  | Statistics and Probability | . 1180 | . 1954 | 10 |
|  | Total | . 1315 | . 2141 | 75 |

Table 160. Grade 11 Math P+ and Adjusted P+ by Tier and Domain


Figure 122. Grade 11 Math Heat Map of P+ by Tier and Domain


Figure 123. Grade 11 Math Heat Map of Adjusted P+ by Tier and Domain

## Discussion and Implications

In phase one of this investigation, analyses revealed that item difficulty consistently orders by tier for all grade and content area tests with few exceptions. Of the 14 tests analyzed encompassing 42 adjacent tier comparisons (i.e. $1 / 2,2 / 3$, and $3 / 4$ ), tier 'reversals' occurred in only 4 instances. Modest reversals occurred between tiers 2 and 3 in grades 3 and 4 ELA. Slight reversals occurred between tiers 3 and 4 for grades 5 and 7 math. All other comparisons ordered as described by difficulty, although it was not unusual to observe small differences between tiers 2 and 3 . Also noteworthy is that tier 1 items were consistently dissimilar from all other tiers; these items were distinctly less difficult with no exceptions.

Across the content domains, there was little evidence of a pattern of difficulty with the exception that in ELA reading informational text was consistently more difficult across grades. Encouragingly, the ordering of p-values by tiers generally holds across content domains. While there is some fluctuation in the overall difficulty of the domains, the tiers typically order within the domains, particularly when comparing tier 1to all other tiers. However, both the paucity of items within each domain by tier and the differences in the proportions of tiers in each domain limit interpretation and suggest more research is prudent.

In phase two, we observed similar patterns of item order by difficulty corresponding to the tiers. However, the strength of the differences was less pronounced, especially when using P+. That is, the items generally increased in difficulty for higher tiers, but these increases were often very small. For example, in grade 3 math the difference in difficulty between the Tier 1 and Tier 2 item was .17 (. 68 .51). However, that difference was only .01 (.18-.17) using P+ and .10 (.36-.26) using Adjusted P+. Moreover, although a reversal in difficulty (i.e. the higher tier exhibits lower difficulty) between adjacent tiers was uncommon, there were more reversals using P+ compared to p -value and Adjusted $\mathrm{P}+$. For the eight grade and content tests examined with all three metrics ( p -value, $\mathrm{P}+$, and Adjusted $\mathrm{P}+$ ), we found two reversals in the 24 comparisons using p-value and Adjusted $\mathrm{P}+$ and five reversals using $\mathrm{P}+$. Each of the reversals was very slight in degree. The table below shows this result across all eight tests for each metric and adjacent tier comparison. Each cell represents the difference in item difficulty, where a positive value signals the lower tier was less difficult. Cells with reversals are shaded in red.

|  | P-Value |  |  |  | P+ |  |  | Adjusted P+ |  |  |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | :---: | :---: |
|  | Tier 1/2 | Tier 2/3 | Tier 3/4 | Tier 1/2 | Tier 2/3 | Tier 3/4 | Tier 1/2 | Tier 2/3 |  |  |
| Tier 3/4 |  |  |  |  |  |  |  |  |  |  |
| Grade 3 ELA | 0.16 | 0.04 | -0.03 | -0.01 | 0.03 | -0.03 | 0.12 | 0.06 |  |  |
| Grade 3 Math | 0.17 | 0.05 | 0.06 | 0.01 | 0.04 | 0.06 | 0.10 | 0.06 |  |  |
| Grade 5 ELA | 0.24 | 0.01 | 0.03 | 0.07 | 0.01 | 0.03 | 0.23 | 0.01 |  |  |
| Grade 5 Math | 0.23 | 0.08 | $-<.01$ | 0.06 | 0.06 | -0.02 | 0.18 | 0.09 |  |  |
| Grade 8 ELA | 0.13 | 0.10 | 0.08 | -0.03 | 0.10 | 0.07 | 0.07 | 0.15 |  |  |
| Grade 8 Math | 0.18 | 0.05 | 0.04 | 0.01 | 0.05 | 0.04 | 0.11 | 0.07 |  |  |
| Grade 11 ELA | 0.12 | 0.13 | 0.03 | -0.05 | 0.12 | 0.03 | 0.07 | 0.19 |  |  |
| Grade 11 Math | 0.22 | 0.04 | 0.05 | 0.05 | 0.03 | 0.05 | 0.17 | 0.04 |  |  |

Table 161. Differences in Item Difficulty for Adjacent Tiers for P-Value, P+, and Adjusted P+
Overall, the evidence suggests that even when adjusting for the number of response items, the pattern of increasing difficulty for higher tiers holds, but the differences are less distinct and there are more exceptions. We believe these findings can be helpful to identify the tiers and domains that merit further research to better understand the nature of performance differences and determine if or how changes to item specifications, administration, and/or instruction are warranted.

With respect to the spread of items across the student ability distribution, our analyses show that ELA items tend to cluster in the lower to middle deciles whereas the math items tend to cluster in the middle to upper deciles. These results support the claim that item design and development efforts were successful in producing items that are accessible for a range of student abilities.

One exception is that the finding items do not fall into the first decile when including students who received the lowest obtainable scale score (LOSS). However, we suggest these analyses may confound rather than clarify interpretation. Evidence suggests that students scoring at the LOSS interacted with little or no test content (as opposed to attempting all or most items and getting them incorrect). These students likely have communication challenges that prohibit demonstration of their knowledge and skills.

Moving forward, it may be prudent to disproportionally target new item development to tiers 3 and 4 for ELA and tiers 1 and 2 for math in order to improve the spread of items across the distribution. This will also help the program make the most out of adaptive designs if desired. However, it is important to ensure that efforts to improve the spread of item difficulty do not diminish information in the region of the cut scores, which will reduce classification accuracy. That is, some disproportionality of item difficulty such that items cluster in the middle deciles is expected and appropriate.

These investigations suggest areas for future research. First, analyses should be repeated for p -values adjusted by response options to see if the patterns continue to hold or if there is some evidence they are obscured by guessing or other factors. Second, because content domain is a very broad category, it would be worthwhile to inspect performance with respect to more specific or 'granular' measurement targets to build and test hypotheses about how item features and characteristics support student demonstration of knowledge for specific skills.

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[^0]:    ${ }^{1}$ The P+ approach and term was suggested by Professor Derek Briggs in a NCSC Technical Advisory Committee meeting.

[^1]:    Table 6. Grade 3 ELA (p-value and domain) MC Items

[^2]:    Table 57. Grade 3 Math (p-value and tier) MC Items

[^3]:    Table 63. Grade 3 Math (p-value of domain by tier) - All items

[^4]:    Table 72. Grade 4 Math (p-value and domain) - MC Items

[^5]:    Table 73. Grade 4 Math (p-value and domain) - CR Items

[^6]:    Table 82. Grade 5 Math ( $p$-value and tier) CR Items

[^7]:    Table 87. Grade 5 Math (p-value of domain by tier) - All items

[^8]:    Table 95. Grade 6 Math (p-value of domain by tier) - All items

[^9]:    Table 106. Grade 8 Math (p-value and tier) MC Items

[^10]:    Table 131. Grade 3 ELA Items by Domain and Tier.

[^11]:    Table 139. Grade 8 ELA Items by Tier and Domain

