

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

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Center for Assessment

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Development of this report was supported by a grant from the U.S. Department of Education, Office of Special Education Programs (H373X100002, Project Officer: <u>Susan.Weigert@ed.gov</u>). The contents do not necessarily represent the policy of the U.S. Department of Education, and no assumption of endorsement by the Federal government should be made.

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

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December 2016

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 p-value 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: P+ and Adjusted 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, P+, and Adjusted P+), we found two reversals in the 24 comparisons using p-value and Adjusted P+ and five reversals using 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 p-value 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 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 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 solution item with a p-value of .77 would have a P+ of .44 (.77 - .33).

We noted that the P+ has a 'ceiling effect' insofar as no item can receive a 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 P+, in which we simply divide the 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 P+ of .30 (.80-.50) and an Adjusted P+ of .60 (.30/.50). A three choice item with a p-value of .80 would be assigned a P+ of .47 (.80-.33) and an adjusted 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: The probability of guessing on a two-choice item is set to .5 The probability of guessing on a three-choice item is set to .33 P+ = percent correct - probability of guessing
Adjusted P+	P+ (defined above) divided by the upper limit of the P+, which is one minus the probability of guessing. $Adjusted P+=\frac{P+}{1-probability of guessing}$

¹ The P+ approach and term was suggested by Professor Derek Briggs in a NCSC Technical Advisory Committee meeting.

Table 1. Description of P-Value, P+, and Adjusted P+

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 P+ and Adjusted 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 ½ 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	Ν
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	Ν
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



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



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 p-value (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 Prompt-Narrative 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.

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Domain	p-value	Ν
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

Grade 3 ELA (p-value and domain) – All Items

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 a	and domain)	MC Items
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Domain	p-value	Ν
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 6. 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 ½ 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 p-value 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

Table 8. Grade 3 ELA Items by Domain and Tier

Tier	Domain	p-value	Ν
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

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

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

Writing Prompt-Narrative	0.68 (6)				P–Value
Writing Informational	0.84 (1)	0.78 (1)	0.55 (1)	0.57 (1)	0.8
Reading Literature	0.82 (4)		0.56 (10)	0.63 (5)	0.6
Reading Informational Text	0.8 (4)	0.57 (10)	0.53 (8)		0.5
Reading at Word Level	0.89 (1)	0.76 (1)	0.66 (4)	0.5 (1)	0.4
Foundational-Reading at Word Level		0.46 (10)	0.48 (5)	0.33 (5)	0.3
	1	2 Ti	3 er	4	

ELA, Grade 3

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

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

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

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 Decile	Number of Items	Percent 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 Decile	Number of Items	Percent 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





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 the13 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 ½ 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 ½ 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.

Tier	p-value	Ν
Tier 1	.767778	18
Tier 2	.530952	21
Tier 3	.550333	30
Tier 4	.433077	13
Total	.574512	82

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

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



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



ELA (p-value and tier) CR Items

Tier	p-value	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



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



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	Ν
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 p-values 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

Writing Prompt–Narrative	0.72 (4)				P–Value
Writing Informational	0.71 (1)	0.6 (1)	0.6 (1)	0.44 (1)	0.8
Reading Literature	0.81 (5)		0.6 (12)	0.54 (6)	0.6
Reading Informational Text	0.78 (4)	0.56 (9)	0.48 (10)		0.5
Reading at Word Level	0.72 (1)	0.47 (1)	0.66 (2)	0.56 (1)	0.4
Foundational-Reading at Word Level	0.77 (3)	0.5 (10)	0.5 (5)	0.28 (5)	0.3
	1	2 Ti	er 3	4	

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

ELA, Grade 4

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

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	

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

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 Decile	Number of Items	Percent 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

Table 24. Grade 4 ELA Items by Decile



Figure 15. Grade 4 ELA Items by Decile

Grade 4 ELA Items by Decile LOSS Excluded

Ability Decile	Number of Items	Percent 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 the14 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 $\frac{1}{2}$ as many items as Tier 3, and Tier 4 has $\frac{1}{3}$ 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



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 $\frac{1}{2}$ as many items (4) as the Reading Domains.

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

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

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

Table 28. Grade 5 ELA Items by Domain and Tier
Grade 5 ELA (p-value of domain by tier) - All Items

Tier	Domain	p-value	Ν
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

Writing Prompt–Narrative	0.72 (4)				P–Value
Writing Informational	0.84 (1)	0.72 (1)	0.44 (1)	0.46 (1)	0.7
Reading Literature	0.8 (4)		0.54 (14)	0.52 (6)	0.6
Reading Informational Text	0.81 (3)	0.52 (10)	0.48 (8)		0.5
Reading at Word Level	0.7 (2)	0.51 (1)	0.57 (4)	0.35 (1)	0.3
	1	2 Ti	er 3	4	

ELA, Grade 5

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.

Ability Decile	Number of Items	Percent 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

Grade 5 ELA Items by Decile





Figure 20. Grade 5 ELA Items by Decile

Ability Decile	Number of Items	Percent 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

Grade 5 ELA Items by Decile LOSS Excluded

Table 31. 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.

Tier	p-value	Ν
Tier 1	.779130	23
Tier 2	.625789	19
Tier 3	.539200	25
Tier 4	.441429	7
Total	.626757	74

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

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 Prompt-Expository Domain. The highest p-value is at the Reading at Word Level Domain and the total p-value by domains is 63%.

Although the percentage of students responding correctly for the five domains are similar, there are approximately ½ 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.

Domain	p-value	Ν
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

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

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 ½ 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	Ν
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	.660000	1
	Total	.539200	25
Tier 4	Reading at Word Level	.580000	1
	Reading Informational Text	.402000	5
	Writing Literary	.500000	1
	Total	.441429	7
Total	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 35. Grade 6 ELA (p-value of domain by tier) – All Items

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



ELA, Grade 6

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.

Ability Decile	Number of Items	Percent 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

Grade 6 ELA Items by Decile

Table 36. Grade 6 ELA Items by Decile



Figure 25. Grade 6 ELA Items by Decile.

Ability Decile	Number of Items	Percent 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

Grade 6 ELA Items by Decile LOSS Excluded

Table 37. 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 CR 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 $\frac{1}{2}$ as many items as Tier 2.

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

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

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



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 ½ 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 ¼ as many items (4, 6 respectively) as the Reading Domains.

Domain	p-value	Ν
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

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

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 ½ 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	Ν
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
	Total	.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

P-Value 0.68 Writing Prompt-Expository (6) 0.8 0.84 0.62 0.35 0.54 Writing Literary 0.7 (1) (1) (1) 0.62 0.59 0.6 Reading Literature (14)(10)0.5 0.78 0.47 0.49 Reading Informational Text (15) 0.4 0.75 0.59 0.55 0.51 Reading at Word Level (3) (3) (4) (1) 0.3 1 2 3 4 Tier

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

ELA, Grade 7

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.

Ability Decile	Number of Items	Percent 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

Grade 7 ELA Items by Decile

Table 42. Grade 7 ELA Items by Decile



Figure 30. Grade 7 ELA Items by Decile

Ability Decile	Number of Items	Percent 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

Grade 7 ELA Items by Decile LOSS Excluded

Table 43. Grade 7 ELA Items by Decile LOSS Excluded



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 1 provides 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 ½ as many items as the other tiers.

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

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

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



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

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

Items Difficulty by Domain

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 Prompt-Expository and Writing Prompt-Persuasive Domains have less than 1/10 as many items (4, 6 respectively) as the Reading Informational Text Domain.

Domain	p-value	Ν
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

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

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

ELA, Grade 8

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.

Ability Decile	Number of Items	Percent 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

Grade 8 ELA Items by Decile





Figure 35. Grade 8 ELA Items by Decile

Ability Decile	Number of Items	Percent 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

Grade 8 ELA Items by Decile LOSS Excluded

Table 49. 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 1 provides 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 $\frac{1}{2}$ as many items as Tiers 1 and 3.

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

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

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



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 ½ 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) – 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

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

Table 52. Grade 11 ELA Items by Domain and Tier

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



ELA, Grade 11

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.

Ability Decile	Number of Items	Percent 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

Grade 11 ELA Items by Decile



55

100.0

Total



Figure 40. Grade 11 ELA Items by Decile

Ability Decile	Number of Items	Percent 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

Grade 11 ELA Items by Decile LOSS Excluded

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 Tier1 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 MC, CR, or combined items. It is not surprising that these items have the lowest p-value, as they have 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 = 51%, MC Items p-value = 51%, CR Items p-value = 54%; Tier 3 All Items p-value = 47%, MC Items p-value = 46%, CR Items p-value = 51%).

Tier	p-value	N
Tier 1	.684375	16
Tier 2	.513333	30
Tier 3	.468333	24
Tier 4	.405000	10
Total	.520500	80

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

Table 56. 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

Table 57. Grade 3 Math (p-value and tier) MC Items



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

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

Tier	p-value	Ν
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 ½ 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.

Domain	p-value	Ν
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

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

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	73

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



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	Ν
Measurement and Data	.524286	7
Total	.524286	7

Table 61. Grade 3 Math (p-value and domain) - CR Items

Item Difficulty by Domain and Tier

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 p-value 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 d	omain by tier) - All items
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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 Base Ten .403333 3 Operations and Algebraic Thinking .410000 7 Total .468333 24 Tier 4 Geometry .590000 1 <	Tier	Domain	p-value	N
Measurement and Data.6733333Number and Operations Base Ten.6625004Number and Operations Fractions.7166673Operations and Algebraic Thinking.6625004Total.68437516Tier 2Geometry.5966673Measurement and Data.5385717Number and Operations Base Ten.4466673Number and Operations Fractions.4162508Operations and Algebraic Thinking.5744449Total.51333330Tier 3Geometry.5775004Measurement and Data.5025004Number and Operations Base Ten.4733336Number and Operations Base Ten.4733336Number and Operations Base Ten.4733333Operations and Algebraic Thinking.4100007Total.46833324Tier 4Geometry.5900001Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Base Ten.4200002Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333Total.40500010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Base Ten.5	Tier 1	Geometry	.740000	2
Number and Operations Base Ten.6625004Number and Operations Fractions.7166673Operations and Algebraic Thinking.6625004Total.68437516Tier 2Geometry.5966673Measurement and Data.5385717Number and Operations Base Ten.4466673Number and Operations Fractions.4162508Operations and Algebraic Thinking.5744449Total.51333330Tier 3Geometry.5775004Measurement and Data.5025004Number and Operations Base Ten.4733336Number and Operations Base Ten.4733336Number and Operations Base Ten.4733336Number and Operations Fractions.4033333Operations and Algebraic Thinking.4100007Total.5900001Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333Total.66000010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315		Measurement and Data	.673333	3
Number and Operations Fractions Operations and Algebraic Thinking Total.7166673Tier 2Geometry.5966673Measurement and Data Number and Operations Base Ten Number and Operations Fractions.4466673Number and Operations Fractions Operations and Algebraic Thinking Total.5744449Tier 3Geometry.5775004Measurement and Data Number and Operations Fractions.5025004Number and Operations Fractions Operations and Algebraic Thinking Measurement and Data Number and Operations Fractions.6023004Number and Operations Fractions Number and Operations Fractions.4733336Number and Operations Fractions Algebraic Thinking Aluo00.4033333Operations and Algebraic Thinking Measurement and Data Number and Operations Fractions.40333324Tier 4Geometry Measurement and Data Number and Operations Base Ten Ad68333.4200002Number and Operations Fractions Operations and Algebraic Thinking Measurement and Data.3233333Tier 4Geometry Measurement and Data Number and Operations Fractions.3900002Operations and Algebraic Thinking Measurement and Data Number and Operations Fractions.3233333Total.40500010TotalGeometry Measurement and Data Number and Operations Base Ten Ad05000.51133315Number and Operations Base Ten Ad05000.51133315Number and Operations Base Ten Ad05000.511333		Number and Operations Base Ten	.662500	4
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		Number and Operations Fractions	.716667	3
Total.68437516Tier 2Geometry.5966673Measurement and Data.5385717Number and Operations Base Ten.4466673Number and Operations Fractions.4162508Operations and Algebraic Thinking.5744449Total.51333330Tier 3Geometry.5775004Measurement and Data.5025004Number and Operations Base Ten.4733336Number and Operations Base Ten.4733333Operations and Algebraic Thinking.4100007Total.46833324Tier 4Geometry.5900001Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Base Ten.4200002Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333Total.40500010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.54187516Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315		Operations and Algebraic Thinking	.662500	4
Tier 2Geometry Measurement and Data Number and Operations Base Ten Number and Operations Fractions.596667 .5385713Number and Operations Base Ten Number and Operations Fractions.446667 .4162503Operations and Algebraic Thinking Total.5744449Total.51333330Tier 3Geometry Measurement and Data Number and Operations Base Ten Number and Operations Fractions.5025004Number and Operations Fractions Operations and Algebraic Thinking Uperations and Algebraic Thinking.4033333Operations and Algebraic Thinking Mumber and Operations Fractions.40333324Tier 4Geometry Measurement and Data Number and Operations Base Ten Mumber and Operations Base Ten Number and Operations Base Ten Number and Operations Base Ten Mumber and Operations Fractions Operations and Algebraic Thinking Mumber and Operations Fractions Mumber and Operations Fractions Mumber and Operations Base Ten Mumber and Operations Base Ten Mumber and Operations Fractions Mumber and Operations Fractions Mumber and Operations Fractions Mumber and Operations Fractions Mumber and Operations Base Ten Mumber And Operations Base Ten.54187516Number and Oper		Total	.684375	16
Measurement and Data.5385717Number and Operations Base Ten.4466673Number and Operations Fractions.4162508Operations and Algebraic Thinking.5744449Total.51333330Tier 3Geometry.5775004Measurement and Data.5025004Number and Operations Base Ten.4733336Number and Operations Fractions.4033333Operations and Algebraic Thinking.4100007Total.46833324Tier 4Geometry.5900001Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Fractions.446833324Tier 4Geometry.5900001Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.323333Total.60500010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315	Tier 2	Geometry	.596667	3
Number and Operations Base Ten.4466673Number and Operations Fractions.4162508Operations and Algebraic Thinking.5744449Total.51333330Tier 3Geometry.5775004Measurement and Data.5025004Number and Operations Base Ten.4733336Number and Operations Fractions.4033333Operations and Algebraic Thinking.4100007Total.46833324Tier 4Geometry.5900001Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Base Ten.4200002Number and Operations Base Ten.4200002Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333TotalGeometry.61700010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315		Measurement and Data	.538571	7
Number and Operations Fractions.4162508Operations and Algebraic Thinking.5744449Total.51333330Tier 3Geometry.5775004Measurement and Data.5025004Number and Operations Base Ten.4733336Number and Operations Fractions.40333333Operations and Algebraic Thinking.4100007Total.46833324Tier 4Geometry.5900001Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333Operations and Algebraic Thinking.3233333Tier 4Geometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315		Number and Operations Base Ten	.446667	3
Operations and Algebraic Thinking Total.5744449Total.51333330Tier 3Geometry.5775004Measurement and Data.5025004Number and Operations Base Ten.4733336Number and Operations Fractions.4033333Operations and Algebraic Thinking.4100007Total.46833324Tier 4Geometry.5900001Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333Total.40500010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315		Number and Operations Fractions	.416250	8
Total.51333330Tier 3Geometry.5775004Measurement and Data.5025004Number and Operations Base Ten.4733336Number and Operations Fractions.4033333Operations and Algebraic Thinking.4100007Total.46833324Tier 4Geometry.5900001Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333TotalGeometry.61700010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Fractions.51133315		Operations and Algebraic Thinking	.574444	9
Tier 3Geometry Measurement and Data.5775004Measurement and Data.5025004Number and Operations Base Ten Number and Operations Fractions.4733336Number and Operations Fractions.4033333Operations and Algebraic Thinking.4100007Total.46833324Tier 4Geometry Number and Operations Base Ten Number and Operations Fractions.5900001Measurement and Data.4350002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333Total.40500010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.54187516Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315		Total	.513333	30
Measurement and Data.5025004Number and Operations Base Ten.4733336Number and Operations Fractions.4033333Operations and Algebraic Thinking.4100007Total.46833324Tier 4Geometry.5900001Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333TotalGeometry.61700010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.54187516Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315	Tier 3	Geometry	.577500	4
Number and Operations Base Ten.4733336Number and Operations Fractions.4033333Operations and Algebraic Thinking.4100007Total.46833324Tier 4Geometry.5900001Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333TotalGeometry.61700010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.54187516Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315		Measurement and Data	.502500	4
Number and Operations Fractions.4033333Operations and Algebraic Thinking.4100007Total.46833324Tier 4Geometry.5900001Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333TotalGeometry.61700010TotalGeometry.54187516Number and Operations Base Ten.54187516Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315		Number and Operations Base Ten	.473333	6
Operations and Algebraic Thinking.4100007Total.46833324Tier 4Geometry.5900001Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333Total.40500010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315		Number and Operations Fractions	.403333	3
Total.46833324Tier 4Geometry.5900001Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333Total.40500010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315		Operations and Algebraic Thinking	.410000	7
Tier 4Geometry.5900001Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333Total.40500010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Base Ten.51133315		Total	.468333	24
Measurement and Data.4350002Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333Total.40500010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315	Tier 4	Geometry	.590000	1
Number and Operations Base Ten.4200002Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333Total.40500010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Fractions		Measurement and Data	.435000	2
Number and Operations Fractions.3900002Operations and Algebraic Thinking.3233333Total.40500010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Fractiona.5235516		Number and Operations Base Ten	.420000	2
Operations and Algebraic Thinking.3233333Total.40500010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Fractiona.5235516		Number and Operations Fractions	.390000	2
Total.40500010TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Fractiona.5225516		Operations and Algebraic Thinking	.323333	3
TotalGeometry.61700010Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Fractions		Total	.405000	10
Measurement and Data.54187516Number and Operations Base Ten.51133315Number and Operations Fractions	Total	Geometry	.617000	10
Number and Operations Base Ten .511333 15		Measurement and Data	.541875	16
Number and Operations Fractions		Number and Operations Base Ten	.511333	15
		Number and Operations Fractions	.466875	16
Operations and Algebraic Thinking .506957 23		Operations and Algebraic Thinking	.506957	23
Total .520500 80		Total	.520500	80

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

Operations and Algebraic Thinking	0.66 (4)	0.57 (9)	0.41 (7)	0.32 (3)	P-Value
Number and Operations Fractions	0.72 (3)	0.42 (8)	0.4 (3)	0.39 (2)	0.7
Number and Operations Base Ten	0.66 (4)	0.45 (3)	0.47 (6)	0.42 (2)	0.6
Measurement and Data	0.67 (3)	0.54 (7)	0.5 (4)	0.44 (2)	0.5
Geometry	0.74 (2)	0.6 (3)	0.58 (4)	0.59 (1)	0.3
	1	2 Ti	3 er	4	-

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

Math, Grade 3

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	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

Number of Items	Percent of Items
0	0
2	2.5
8	10.0
8	10.0
7	8.8
16	20.0
13	16.3
11	13.8
10	12.5
5	6.3
80	100.0
	Number of Items 0 2 8 7 16 13 11 10 5 80

Table 66. Grade 3 Math Items by Decile



Figure 48. Grade 3 Math Items by Decile

Grade 5 Main henry by Deche LOSS Excluded	Grad	le :	3	Math	Items	by	Decile	LOSS	Excluded
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Ability Decile	Number of Items	Percent 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.





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 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 p-value 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%, MC Items p-value = 42%, 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) All Items

Tier	p-value	Ν
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



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



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	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



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 ½ 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.

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	78

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

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

Table 72. Grade 4 Math (p-value and domain) – MC Items



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

Table 73. Grade 4 Math (p-value and domain) - CR Items



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 $\frac{1}{2}$ as many items as Tier 1 (17) and $\frac{1}{4}$ 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

Table 74. Grade 4 Math Items by Domain and Tier

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
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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

	Math, Grade 4				
Operations and Algebraic Thinking	0.68 (3)	0.4 (7)	0.41 (9)	0.36 (3)	P–Value
Number and Operations Fractions	0.62 (6)	0.37 (6)	0.39 (7)	0.41 (1)	0.7
Number and Operations Base Ten	0.62 (2)	0.5 (3)	0.42 (3)	0.45 (1)	0.6
Measurement and Data	0.74 (4)	0.37 (7)	0.44 (5)	0.45 (1)	0.5
Geometry	0.78 (2)	0.62 (4)	0.5 (3)	0.19 (1)	0.3
	1	2 Ti	3 er	4	-

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
	(p-value	or aomain	by tion	j = 100 from 3

Tier	Domain	p-value	Ν
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 Decile	Number of Items	Percent 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 Decile	Number of Items	Percent 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 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 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 Tier1 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.

Tier	p-value	Ν	
Tier 1	.687647	17	
Tier 2	.458571	28	
Tier 3	.377037	27	
Tier 4	.378750	8	
Total	.471750	80	

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

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



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	Ν
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



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

Table 82. Grade 5 Math (p-value and tier) CR Items



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	Ν
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

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



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	77

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



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 ½ 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%.

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

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

Table 87. Grade 5 Math (p-value of domain by tier) - All items

P-Value 0.7 0.53 0.36 Operations and Algebraic Thinking (4) (1) (1) 0.8 0.61 0.46 0.41 0.47 Number and Operations Fractions (4) - 0.7 0.74 0.49 0.39 0.42 0.6 Number and Operations Base Ten (7) 0.5 0.4 0.68 0.37 0.37 Measurement and Data (4) 0.4 0.46 0.68 0.28 Geometry (1) (2) 0.3 3 1 2 4 Tier

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

Math, Grade 5

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	Ν
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	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 Decile	Number of Items	Percent 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 Decile	Number of Items	Percent 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





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 ½ 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	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.

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

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

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



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 p-value is 55% for all domains and all tiers (79 items). It is important to note that Tiers 1 and 4 have the $\frac{1}{2}$ 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

Table 95. Grade 6 Math (p-value of domain by tier) - All items

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

The Number System	0.64 (4)	0.58 (11)	0.53 (7)	0.51 (3)	P–Value
Statistics and Probability	0.76 (2)	0.44 (3)	0.49 (1)		0.7
Ratio and Proportions	0.75 (5)	0.59 (7)	0.47 (11)	0.4 (2)	0.6
Expressions and Equations	0.76 (2)	0.57 (5)	0.46 (6)	0.42 (2)	0.5
Geometry	0.82 (2)	0.48 (2)	0.43 (3)	0.38 (1)	0.3
	1	2 Ti	3 er	4	

Math, Grade 6

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
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Ability Decile	Number of Items	Percent 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





Ability Decile	Number of Items	Percent 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

Grade 6 Math Items by Decile LOSS Excluded

Table 98. 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 Tier1 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.

Tier	p-value	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

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

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 ½ 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).

Domain	p-value	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

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

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

Table 101. Grade 7 Math Items by Domain and Tier

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

The Number System	0.64 (2)	0.43 (7)	0.45 (5)	0.46 (2)	P–Value
Statistics and Probability	0.88 (1)	0.61 (4)	0.49 (3)		0.7
Ratio and Proportions	0.76 (6)	0.52 (11)	0.43 (11)	0.49 (1)	0.6
Expressions and Equations	0.73 (2)	0.48 (3)	0.48 (4)	0.53 (1)	0.5
Geometry	0.69 (3)	0.59 (7)	0.45 (6)	0.37 (1)	0.3
	1	2 Ti	3 er	4	

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

Math, Grade 7

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^{th} decile. When the LOSS is excluded, there is a particularly pronounced spike of 25 items in decile 7.

Ability Decile	Number of Items	Percent 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			

Grade 7 Math Items by Decile

Table 103. Grade 7 Math Items by Decile



Figure 74. Grade 7 Math Items by Decile

Ability Decile	Number of Items	Percent 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

Grade 7 Math Items by Decile LOSS Excluded

Table 104. 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 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. 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%).

Tier	p-value	Ν
Tier 1	.676250	16
Tier 2	.496667	27
Tier 3	.449333	30
Tier 4	.413333	6
Total	.508734	79

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

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	N
Tier 1	.676250	16
Tier 2	.496667	27
Tier 3	.445357	28
Tier 4	.400000	5
Total	.509211	76

Table 106. Grade 8 Math (p-value and tier) MC Items

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	N
Tier 3	.505000	2
Tier 4	.480000	1
Total	.496667	3

Table 107. 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 ½ 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 p-value for the MC items is 51%.

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



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	76

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

Table 110. Grade 8 Math (p-value and domain) - CR Items

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 $\frac{1}{2}$ 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%.

Tier	Domain	p-value	Ν
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

Math, Grade 8					
Functions	0.64 (4)	0.52 (5)	0.39 (6)	0.48 (1)	P–Value
The Number System	0.78 (2)	0.42 (2)	0.43 (3)	0.37 (1)	0.7
Statistics and Probability	0.67 (4)	0.49 (6)	0.49 (5)	0.38 (2)	0.6
Expressions and Equations	0.53 (2)	0.41 (5)	0.44 (6)	0.45 (1)	0.5
Geometry	0.74 (4)	0.55 (9)	0.48 (10)	0.42 (1)	0.3
	1	2 Ti	3 er	4	

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

Tier	Domain	p-value	Ν
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	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 Decile	Number of Items	Percent 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 Decile	Number of Items	Percent 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





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 Tier1 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%).

Tier	p-value	Ν
Tier 1	.682143	14
Tier 2	.467667	30
Tier 3	.432000	30
Tier 4	.385000	6
Total	.485625	80

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

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



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	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



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	Ν
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



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 p-values 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 p-value (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 ½ 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	Ν
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 ½ 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 p-value 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%).

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

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

Table 124. Grade 11 Math (p-value of domain by tier) - All items
Number and Quantity	0.65 (3)	0.46 (6)	0.4 (6)	0.36 (1)	P–Value
Algebra And Functions	0.71 (8)	0.49 (17)	0.47 (14)	0.44 (2)	0.7
Statistics and Probability	0.69 (2)	0.44 (5)	0.42 (6)	0.36 (2)	0.5
Geometry	0.56 (1)	0.38 (2)	0.38 (4)	0.34 (1)	0.4 0.3
	1	2 Ti	er 3	4	

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

Math, Grade 11

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

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

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

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 Decile	Number of Items	Percent 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 Decile	Number of Items	Percent 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 P+. The second calculation is termed Adjusted 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 P+ and Adjusted 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 P+ and Adjusted P+. For that reason, we primarily focus on outcomes within (not across) P+ and Adjusted 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 P+ and Adjusted P+ values varied minimally across each of the tiers. P+ is highest for Tier 2, whereas the Adjusted P+ is highest for Tier 1. Tier 1 has 16 items with a P+ of 27% and an Adjusted P+

of 53%. Tier 2 has 12 items with a P+ of 28% and an Adjusted P+ of 41%. Tier 3 has the most number of items (23) and a P+ of 24% and an Adjusted P+ value of 35%. Tier 4 has the least number of items (7) with a P+ of 27% and an Adjusted P+ of 40%. The total mean P+ value for all 58 items is 26% and 42% for the Adjusted P+ value.

Tier	P+	Adjusted P+	N
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

Grade 3 ELA – P+, Adjusted P+ and Tiers (MC Items)

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



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

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 P+ and Adjusted 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 P+ (18%) as well as the lowest Adjusted P+ (36%). The Reading at Word Level Domain has the highest P+ at 33% and Adjusted 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 P+ for all 58 items is 26% and the Adjusted P+ value is 42%.

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

Domain	P+	Adjusted P+	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

P+ and Adjusted P+ for 58 grade 3 ELA multiple choice items were examined by domain and tier. Overall, we note modestly lower P+ and Adjusted P+ for items in Tiers 3 and 4 across domains, especially for Adjusted P+, but the difference is not as pronounced compared to p-values in phase one. 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

Table 131. Grade 3 ELA Items by Domain and Tier.

TierDomainP+Adjusted P+NTier 1Reading at Word Level0.39000.78001Reading Informational Text0.29750.59504Reading Literature0.31500.63004Writing Informational0.34000.68001Writing Prompt-Narrative0.18000.36006Total0.26630.532516Tier 2Reading at Word Level0.43000.64181Reading Informational Text0.24400.364210Writing Informational Text0.27670.412912Tier 3Reading at Word Level0.33250.49634Reading Informational Text0.20250.30228Reading Informational Text0.22700.338810Writing Informational Text0.22000.32841Total0.22000.32841Total0.23650.353023Tier 4Reading Literature0.29000.4418Mriting Informational0.22000.35821Total0.27000.40307Reading at Word Level0.33140.52297Reading at Word Level0.33140.52297Reading at Word Level0.33140.52297Reading Informational Text0.23860.383622Writing Informational Text0.23650.427219Writing Informational Text0.23660.33140.5229Total0.					
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Writing Prompt-Narrative 0.1800 0.3600 6		Writing Informational	0.3125	0.5096	4
		Writing Prompt-Narrative	0.1800	0.3600	6
lotal 0.2571 0.4210 58		Total	0.2571	0.4210	58

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

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



ELA, Grade 3, P+

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



ELA, Grade 3, Adjusted P+

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 P+ and Adjusted 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 P+ values. Values are highest for Tier 1, with a P+ value of 27% and an Adjusted P+ value of 54% for the 14 items. There are 12 items in Tier 2 with a P+ of 20% and an Adjusted P+ of 30%. P+ for Tier 3 is 20% and the Adjusted P+ is 29% for the 27 items. Tier 4 has the least number of items and the lowest values. The P+ for this tier is 16% and the Adjusted P+ is 24%. The total P+ for all 61 items is 21% and 34% for the Adjusted P+.

Tier	P+	Adjusted P+	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

Grade 5 ELA – P+, Adjusted P+ and Tiers (MC Items)

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



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

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

Item Difficulty by Domain

P+ and Adjusted 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 P+ of 31%. The Reading Literature Domain has a P+ at 22% and Adjusted P+ at 35%. The Writing Informational Domain has a P+ at 24% and Adjusted P+ at 41%. The Writing Prompt-Narrative Domain has a P+ of 23% and Adjusted P+ at 45%. The total mean P+ for all 61 items is 21% and the Adjusted P+ is 34%.

Domain	P+	Adjusted P+	Ν
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 P+. 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 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

Tier	Domain Deading at Ward Laval	P+	Adjusted P+	N
Tier 1	Reading at word Level	0.1950	0.3900	Z
	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

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

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

Writing Prompt-Narrative	0.22 (4)				0.8
Writing Informational	0.34 (1)	0.39 (1)	0.11 (1)	0.13 (1)	0.6
Reading Literature	0.3 (4)		0.21 (14)	0.19 (6)	0.4
Reading Informational Text	0.31 (3)	0.18 (10)	0.16 (8)		0.2
Reading at Word Level	0.2 (2)	0.18 (1)	0.24 (4)	0.02 (1)	0.0
	1	2 Ti	3 ier	4	

ELA, Grade 5, P+

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

Writing Prompt–Narrative	0.45 (4)				0.8
Writing Informational	0.68 (1)	0.58 (1)	0.16 (1)	0.19 (1)	0.6
Reading Literature	0.6 (4)		0.31 (14)	0.29 (6)	0.4
Reading Informational Text	0.62 (3)	0.28 (10)	0.24 (8)		0.2
Reading at Word Level	0.39 (2)	0.27 (1)	0.35 (4)	0.03 (1)	0.0
	1	2 Ti	3 er	4	

ELA, Grade 5, Adjusted P+

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 P+ values and the Adjusted 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 P+ of 44%. P+ for Tier 3 is 20% and the Adjusted P+ is 30% for the 28 items. Tier 4 has the least number of items and the lowest values for P+, 12%, and Adjusted P+ 18%.

Tier	P+	Adjusted P+	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

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

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



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

Figure 100. Grade 8 ELA P+ and Adjusted P+ by Tier

Item Difficulty by Domain

P+ and Adjusted 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)

P+ and Adjusted 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 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 P+ of 45%. The total P+ for all domains is 23% and the Adjusted P+ value is 38%.

Domain	P+	Adjusted P+	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

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

Table 138. 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 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 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

Table 139. Grade 8 ELA Items by Tier and Domain

		_		
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

Grade 8 ELA – P+, Adjusted P+ of domain by tier (MC Items)

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

Writing Prompt-Persuasive	0.38 (1)	0.22 (1)	0.36 (1)	0.12 (1)	- 0.8
Writing Prompt-Expository	0.23 (6)				0.6
Reading Literature	0.37 (3)	0.35 (10)	0.2 (10)		0.4
Reading Informational Text	0.22 (10)	0.24 (9)	0.19 (13)	0.13 (9)	0.2
Reading at Word Level	0.29 (3)	0.3 (3)	0.2 (4)	0.04 (1)	0.0
	1	2 Ti	3 er	4	

ELA, Grade 8, P+

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

Writing Prompt–Persuasive	0.76 (1)	0.33 (1)	0.54 (1)	0.18 (1)	0.8
Writing Prompt-Expository	0.45 (6)				0.6
Reading Literature	0.74 (3)	0.53 (10)	0.3 (10)		0.4
Reading Informational Text	0.44 (10)	0.35 (9)	0.28 (13)	0.2 (9)	0.2
Reading at Word Level	0.57 (3)	0.45 (3)	0.29 (4)	0.06 (1)	0.0
	1	2 Ti	3 er	4	

ELA, Grade 8, Adjusted P+

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 P+ and the Adjusted P+ values at each tier. We found 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 P+ value; whereas the items show to be slightly easier at Tier 2 based on P+. There are 19 items for Tier 1 with a P+ of 29% and an Adjusted P+ of 57%. There are 11 items in Tier 2 with a P+ of 33% and an Adjusted P+ of 50%. The P+ value for Tier 3 is 21% and the Adjusted P+ is 31% for the 16 items. Tier 4 has the least number of items and the lowest values; P+ for this tier is 18% and the Adjusted P+ is 27%. The total P+ for all 55 items is 25% and the Adjusted P+ is 43%.

Tier	P+	Adjusted P+	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

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

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



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

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 P+ and Adjusted 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 P+ and Adjusted 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 P+ of 50%. The Reading Literature Domain has a 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 P+ of 40%. The Writing Prompt-Argument has a P+ of 25% and an Adjusted P+ of 51%. The total mean P+ for all domains is 25% and the Adjusted P+ is 43%.

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

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

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 P+ and Adjusted P+ for Tiers 3 and 4 compared to Tiers 1 and 2 across all domains. This finding appears to be more pronounced for Adjusted P+ compared to 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

Table 143. Grade 11 ELA Items by Domain and Tier

Tier	Domain	P+	Adjusted P+	N
Tier 1	Reading at Word Level	.3150	.6300	2
	Reading Informational Text	.2957	.5914	7
	Reading Literature	.3367	.6733	3
	Writing Informational	.2000	.4000	1
	Writing Prompt-Argument	.2533	.5067	6
	Total	.2858	.5716	19
Tier 2	Reading at Word Level	.3800	.5672	2
	Reading Literature	.3150	.4701	8
	Writing Informational	.3900	.5821	1
	Total	.3336	.4980	11
Tier 3	Reading at Word Level	.2733	.4080	3
	Reading Informational Text	.1260	.1881	5
	Reading Literature	.2350	.3507	8
	Total	.2081	.3106	16
Tier 4	Reading at Word Level	.2800	.4179	1
	Reading Informational Text	.1686	.2516	7
	Writing Informational	.1500	.2239	1
	Total	.1789	.2670	9
Total	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

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

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

Writing Prompt-Argument	0.25 (6)				0.8
Writing Informational	0.2 (1)	0.39 (1)		0.15 (1)	0.6
Reading Literature	0.34 (3)	0.32 (8)	0.24 (8)		0.4
Reading Informational Text	0.3 (7)		0.13 (5)	0.17 (7)	0.2
Reading at Word Level	0.32 (2)	0.38 (2)	0.27 (3)	0.28 (1)	0.0
	1	2 Ti	er 3	4	

ELA, Grade 11, P+

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

Writing Prompt-Argument	0.51 (6)				0.8
Writing Informational	0.4 (1)	0.58 (1)		0.22 (1)	0.6
Reading Literature	0.67 (3)	0.47 (8)	0.35 (8)		0.4
Reading Informational Text	0.59 (7)		0.19 (5)	0.25 (7)	0.2
Reading at Word Level	0.63 (2)	0.57 (2)	0.41 (3)	0.42 (1)	0.0
	1	2 Ti	3 er	4	

ELA, Grade 11, Adjusted P+

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 P+ and Adjusted 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. P+ for this tier is 7% and the Adjusted P+ is 11%. There are 26 items in Tier 2 with a P+ of 18% and an Adjusted P+ e of 27% and 22 items in Tier 3 with a P+ of 14% and an Adjusted P+ of 21%. The total mean P+ for all 73 items is 15% and 25% for the Adjusted P+.

Tier	P+	Adjusted P+	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

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

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



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

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 P+ and Adjusted 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 P+ (25%) as well as the highest Adjusted P+ (40%). The Number and Operations Fractions Domain had the lowest P+ at 11% and Adjusted P+ at 18%. The Measurement and Data Domain had a P+ at 17% and Adjusted P+ at 28%. Number and Operations Base Ten Domain had a P+ at 14% and Adjusted P+ at 22%, and Operations and Algebraic Thinking Domain had a P+ at 15% and Adjusted P+ at 24%. The total mean P+ for all 73 items is 15% and the Adjusted P+ is 25%.

Domain	P+	Adjusted P+	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

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

 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 P+ and Adjusted P+ values by tier and domain. Overall, we found a pattern of generally increasing difficulty by tier, which was more prominently observed with Adjusted P+ compared to 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 P+ and especially Adjusted 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

Table 147. Grade 3 Math Items by Tier and Domain

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					
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 Operations and Algebraic Thinking 0.2444 0.3648 9 Total 0.1796 0.2683 0.1287 8 Operations and Algebraic Thinking 0.2444 0.3648 9 Total 0.1796 0.2683 2 Number and Operations Base Ten 0.1433 0.2139 6 Number and Operations Fractions 0.0800 0.1194 3 Operations and Algebraic Thinking 0.0200	Tier 1	Domain	P+	Adjusted P+	N O
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 Base Ten 0.1433 0.2139 1 Operations and Algebraic Thinking 0.0871 0.13	Tier	Geometry	0.2400	0.4800	2
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 0.1824 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 0.1307 0.2056		Measurement and Data	0.1733	0.3467	3
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 0.1377 0.2056 22 Tier 4 Geometry 0.2600 0.3881 1 Measurement and Data 0.0600		Number and Operations Base Ten	0.1625	0.3250	4
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 Fractions	0.2167	0.4333	3
Total0.18440.368816Tier 2 Ier 2 GeometryGeometry0.26670.39803Measurement and Data0.21000.31343Number and Operations Base Ten0.11670.17413Number and Operations Fractions0.08630.12878Operations and Algebraic Thinking0.24440.36489Total0.17960.268126Tier 3Geometry0.24750.36944Measurement and Data0.16500.24632Number and Operations Base Ten0.14330.21396Number and Operations Fractions0.08000.11943Operations and Algebraic Thinking0.08710.13017Total0.13770.205622Tier 4Geometry0.26000.38811Measurement and Data0.04000.05971Number and Operations Base Ten0.90000.13432Number and Operations Base Ten0.09000.13432Number and Operations Base Ten0.09000.13432Number and Operations Fractions0.06000.08962Operations and Algebraic Thinking0.02000.02993Total0.07330.10959Total0.07330.10959Total0.16890.28149Number and Operations Base Ten0.13600.225015Number and Operations Base Ten0.13600.225015 <td></td> <td>Operations and Algebraic Thinking</td> <td>0.1625</td> <td>0.3250</td> <td>4</td>		Operations and Algebraic Thinking	0.1625	0.3250	4
Tier 2 Measurement and Data0.26670.39803Measurement and Data0.21000.31343Number and Operations Base Ten0.11670.17413Number and Operations Fractions0.08630.12878Operations and Algebraic Thinking0.24440.36489Total0.17960.268126Tier 3Geometry0.24750.36944Measurement and Data0.16500.24632Number and Operations Base Ten0.14330.21396Number and Operations Fractions0.08000.11943Operations and Algebraic Thinking0.08710.13017Total0.13770.205622Tier 4Geometry0.26000.38811Measurement and Data0.04000.05971Number and Operations Base Ten0.09000.13432Tier 4Geometry0.26000.38811Measurement and Data0.04000.05971Number and Operations Base Ten0.09000.13432Number and Operations Fractions0.06000.08962Operations and Algebraic Thinking0.025300.402010Number and Operations Base Ten0.16890.28149Number and Operations Base Ten0.16890.28149Number and Operations Base Ten0.16890.28149Number and Operations Base Ten0.16890.225015Number and		Total	0.1844	0.3688	16
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 0.0	Tier 2	Geometry	0.2667	0.3980	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 Geometry 0.2530		Measurement and Data	0.2100	0.3134	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		Number and Operations Base Ten	0.1167	0.1741	3
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 </td <td></td> <td>Number and Operations Fractions</td> <td>0.0863</td> <td>0.1287</td> <td>8</td>		Number and Operations Fractions	0.0863	0.1287	8
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 Geometry 0.2530 0.4020 10 Measurement and Data 0.1689 0.2814 9 Number and Operations Base Ten 0.1360 0.2250 15 Measurement and Data 0.1689 0.2814		Operations and Algebraic Thinking	0.2444	0.3648	9
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 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 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 Base Ten 0.13		Total	0.1796	0.2681	26
Measurement and Data0.16500.24632Number and Operations Base Ten0.14330.21396Number and Operations Fractions0.08000.11943Operations and Algebraic Thinking0.08710.13017Total0.13770.205622Tier 4Geometry0.26000.38811Measurement and Data0.04000.05971Number and Operations Base Ten0.09000.13432Number and Operations Fractions0.06000.08962Operations and Algebraic Thinking0.02000.02993Total0.07330.10959Total0.25300.402010Measurement and Data0.16890.28149Number and Operations Base Ten0.13600.225015Number and Operations Fractions0.16890.28149Total0.16890.251715Operations and Algebraic Thinking0.13600.225015	Tier 3	Geometry	0.2475	0.3694	4
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 0.0733 0.4020 10 Measurement and Data 0.1689 0.2814 9 Number and Operations Base Ten 0.1360 0.2250 15 Number and Operations Base Ten 0.1663 0.1792 15 Operations and Algebraic Thinking 0.1633 0.1792 15 Operations and Algebraic Thinking 0.1530 0.2428		Measurement and Data	0.1650	0.2463	2
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 0.0600 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 0.0733 0.1095 9 Total 0.1689 0.2814 9 Number and Operations Base Ten 0.1689 0.2250 15 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		Number and Operations Base Ten	0.1433	0.2139	6
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 Operations and Algebraic Thinking 0.0600 0.0896 2 Operations and Algebraic Thinking 0.0200 0.0299 3 Total 0.0733 0.1095 9 Total 0.0530 0.4020 10 Measurement and Data 0.1689 0.2814 9 Number and Operations Base Ten 0.1360 0.2250 15 Number and Operations Base Ten 0.1630 0.1792 15 Operations and Algebraic Thinking 0.1633 0.1792 15 Operations and Algebraic Thinking 0.1530 0.2428 23 Total 0.1549 0.2517 72		Number and Operations Fractions	0.0800	0.1194	3
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 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 Base Ten 0.1360 0.2250 15 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		Operations and Algebraic Thinking	0.0871	0.1301	7
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 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		Total	0.1377	0.2056	22
Measurement and Data0.04000.05971Number and Operations Base Ten0.09000.13432Number and Operations Fractions0.06000.08962Operations and Algebraic Thinking0.02000.02993Total0.07330.10959Total0.25300.402010Measurement and Data0.16890.28149Number and Operations Base Ten0.13600.225015Number and Operations Fractions0.10630.179215Operations and Algebraic Thinking0.15300.242823Total0.15490.251772	Tier 4	Geometry	0.2600	0.3881	1
Number and Operations Base Ten0.09000.13432Number and Operations Fractions0.06000.08962Operations and Algebraic Thinking0.02000.02993Total0.07330.10959Total0.25300.402010Measurement and Data0.16890.28149Number and Operations Base Ten0.13600.225015Number and Operations Fractions0.10630.179215Operations and Algebraic Thinking0.15300.242823Total0.15490.251772		Measurement and Data	0.0400	0.0597	1
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 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		Number and Operations Base Ten	0.0900	0.1343	2
Operations and Algebraic Thinking 0.0200 0.0299 3 Total 0.0733 0.1095 9 Total 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		Number and Operations Fractions	0.0600	0.0896	2
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		Operations and Algebraic Thinking	0.0200	0.0299	3
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		Total	0.0733	0.1095	9
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	Total	Geometry	0.2530	0.4020	10
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		Measurement and Data	0.1689	0.2814	9
Number and Operations Fractions 0.1063 0.1792 15 Operations and Algebraic Thinking 0.1530 0.2428 23 Total 0.1549 0.2517 72		Number and Operations Base Ten	0.1360	0.2250	15
Operations and Algebraic Thinking 0.1530 0.2428 23 Total 0.1549 0.2517 72		Number and Operations Fractions	0.1063	0.1792	15
Total 0.1549 0.2517 72		Operations and Algebraic Thinking	0.1530	0.2428	23
		Total	0.1549	0.2517	72

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

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

Operations and Algebraic Thinking	0.16 (4)	0.24 (9)	0.09 (7)	0.02 (3)	0.8
Number and Operations Fractions	0.22 (3)	0.09 (8)		0.06 (2)	0.6
Number and Operations Base Ten	0.16 (4)	0.12 (3)	0.14 (6)	0.09 (2)	0.4
Measurement and Data	0.17 (3)				0.2
Geometry	0.24 (2)	0.27 (3)	0.25 (4)	0.26 (1)	0.0
	1	2 Ti	3 er	4	-

Math Grade 3, P+

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

Operations and Algebraic Thinking	0.32 (4)	0.36 (9)	0.13 (7)	0.03 (3)	- 0.8
Number and Operations Fractions	0.43 (3)	0.13 (8)		0.09 (2)	0.6
Number and Operations Base Ten	0.32 (4)	0.17 (3)	0.21 (6)	0.13 (2)	0.4
Measurement and Data	0.35 (3)				0.2
Geometry	0.48 (2)	0.4 (3)	0.37 (4)	0.39 (1)	0.0
	1	2 Ti	er 3	4	

Math Grade 3, Adjusted P+

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

Grade 5 Math

Item Difficulty by Tier

P+ and Adjusted P+ were examined for 77 multiple choice items in grade 5 math to evaluate item difficulty by tier. We found P+ and Adjusted 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). P+ was highest for Tier 1 at 19% and Adjusted P+ was 38% for these items. P+ is 13% for Tier 2 and Adjusted P+ is 19% for this tier. The P+ for Tier 3 is 7% and the Adjusted P+ is 10%. Finally, Tier 4 was the most difficult with P+ at 8% and Adjusted P+ at 2%. The total mean P+ for all items is 12% and 19% for Adjusted P+.

Tier	P+	Adjusted P+	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

Grade 5 Math – P+, Adjusted P+ and Tiers (MC Items)

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 P+ and Adjusted 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 P+ of 23%. The Number and Operations Fractions Domain had a P+ at 11% and Adjusted P+ at 18%. The Measurement and Data Domain had a P+ at 9% and Adjusted P+ at 16%. Operations and Algebraic Thinking Domain had the lowest P+ and Adjusted P+ values at 8% and 14%, respectively. The total mean P+ for all 77 items is 12% and the Adjusted 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



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

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 P+ and Adjusted P+ by tier and domain. While most Tier 2-4 items were more difficult than Tier 1 based on P+ and Adjusted 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

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

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

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

Operations and Algebraic Thinking	0.2 (1)	0.2 (1)	0.04 (4)	0 (1)	0.8
Number and Operations Fractions	0.11 (4)	0.13 (7)	0.08 (4)	0.14 (1)	0.6
Number and Operations Base Ten	0.24 (7)	0.16 (10)	0.07 (12)	0.09 (4)	0.4
Measurement and Data	0.18 (4)	0.07 (6)	0.06 (5)	0.04 (1)	0.2
Geometry	0.18 (1)	0.13 (4)			0.0
	1	2 Ti	er 3	4	-

Math Grade 5, P+

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

Operations and Algebraic Thinking	0.4 (1)	0.3 (1)	0.06 (4)	0 (1)	0.8
Number and Operations Fractions	0.21 (4)	0.19 (7)	0.13 (4)	0.21 (1)	0.6
Number and Operations Base Ten	0.47 (7)	0.24 (10)	0.1 (12)	0.14 (4)	0.4
Measurement and Data	0.37 (4)	0.11 (6)	0.1 (5)	0.06 (1)	0.2
Geometry	0.36 (1)	0.19 (4)			0.0
	1	2 Ti	3 ier	4	_

Math Grade 5, Adjusted P+

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 P+ and Adjusted P+ at each tier. We found the P+ and Adjusted 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 P+ value of 18% and an Adjusted P+ value of 36% for the 16 items. There are 27 items in Tier 2 with a P+ of 17% and an Adjusted P+ of 25%. The P+ for Tier 3 is 12% and the Adjusted P+ is 17% for the 28 items. Tier 4 has the least number of items (5) and the lowest values; the P+ for this tier is 8% and the Adjusted P+ value is 12%. The total mean P+ for all 76 items is 14% and 24% for the Adjusted P+.

Tier	P+	Adjusted P+	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

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

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



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

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 P+ and Adjusted 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 P+ and Adjusted P+ values varied slightly across all domains. The Geometry Domain had the highest P+ and Adjusted 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 P+ of 21%. The Expressions and Equations Domain (14 items) was most difficult with a 9% P+ value and a 14% Adjusted P+ value. The mean total P+ for all domains is 14% and Adjusted P+ is 24%.

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

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

Table 154. Grade 8 Math P+ and Adjusted P+ by Domain



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

Table 155. Grade 8 Math Items by Tier and Domain

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

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

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

The Number System	0.29 (2)	0.09 (2)	0.1 (3)	0.04 (1)	0.8
Statistics and Probability	0.17 (4)	0.16 (6)			0.6
Functions	0.14 (4)	0.19 (5)	0.07 (6)	0.15 (1)	0.4
Expressions and Equations	0.05 (2)	0.08 (5)	0.11 (6)	0.12 (1)	0.2
Geometry	0.24 (4)	0.22 (9)	0.15 (10)	0.09 (1)	0.0
	1	2 Ti	er 3	4	

Math Grade 8, P+

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

The Number System	0.57 (2)	0.13 (2)	0.15 (3)	0.06 (1)	0.8	
Statistics and Probability	0.34 (4)	0.24 (6)			0.6	
Functions	0.29 (4)	0.29 (5)	0.1 (6)	0.22 (1)	0.4	
Expressions and Equations	0.1 (2)	0.12 (5)	0.16 (6)	0.18 (1)	0.2	
Geometry	0.48 (4)	0.33 (9)	0.22 (10)	0.13 (1)	0.0	
	1 2 3 4 Tier					

Math Grade 8, Adjusted P+

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 P+ and the Adjusted 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 P+ of 19% and an Adjusted P+ of 38% for these 14 items. There are 30 items in Tier 2 with a P+ of 14% and an Adjusted P+ of 21%. The P+ value for Tier 3 is 11% and the Adjusted P+ is 16% for the 26 items. Tier 4 has the least number of items (5) and was most difficult. The P+ for Tier 4 is 6% and the Adjusted P+ is 9%. The mean total P+ for all 75 items is 13% and 21% for the Adjusted P+.

Tier	P+	Adjusted P+	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

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

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



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

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 P+ and Adjusted 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 P+ of 11% and Adjusted P+ of 18%. The mean total P+ for all domains is 13% and the Adjusted P+ is 21%.

Domain	P+	Adjusted P+	Ν
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

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

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



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

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 P+ and Adjusted 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

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

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

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

Number and Quantity	0.17 (3)	0.12 (6)	0.08 (6)	0.03 (1)	0.8
Algebra And Functions	0.21 (8)	0.16 (17)	0.14 (14)	0.12 (2)	0.6
Statistics and Probability	0.19 (2)	0.11 (5)			0.4
Geometry	0.06 (1)	0.04 (2)	0.05 (4)	0.01 (1)	0.0
	1	2 Ti	3 er	4	-

Math Grade 11, P+

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

Number and Quantity	0.33 (3)	0.19 (6)	0.11 (6)	0.04 (1)	0.8
Algebra And Functions	0.43 (8)	0.24 (17)	0.2 (14)	0.17 (2)	0.6
Statistics and Probability	0.38 (2)	0.16 (5)			0.4
Geometry	0.12 (1)	0.07 (2)	0.07 (4)	0.01 (1)	0.0
	1	2 Ti	er 3	4	•

Math Grade 11, Adjusted P+

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 P+. For the eight grade and content tests examined with all three metrics (p-value, P+, and Adjusted P+), we found two reversals in the 24 comparisons using p-value and Adjusted P+ and five reversals using 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-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	-0.05
Grade 3 Math	0.17	0.05	0.06	0.01	0.04	0.06	0.10	0.06	0.10
Grade 5 ELA	0.24	0.01	0.03	0.07	0.01	0.03	0.23	0.01	0.05
Grade 5 Math	0.23	0.08	-<.01	0.06	0.06	-0.02	0.18	0.09	-0.02
Grade 8 ELA	0.13	0.10	0.08	-0.03	0.10	0.07	0.07	0.15	0.12
Grade 8 Math	0.18	0.05	0.04	0.01	0.05	0.04	0.11	0.07	0.05
Grade 11 ELA	0.12	0.13	0.03	-0.05	0.12	0.03	0.07	0.19	0.04
Grade 11 Math	0.22	0.04	0.05	0.05	0.03	0.05	0.17	0.04	0.07

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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