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Children Using the English and Spanish
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Educational Gaming System

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Differences in Performance Between Children Using the English and Spanish Versions of the Ignite
by Hatch™ Educational Gaming System

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This study sought to investigate whether there were performance differences between the children who engaged with the Ignite by Hatch™ educational gaming system using the English- or Spanish-language versions of the games. Differential item functioning methods (DIF) were employed to investigate these differences. Specifically, DIF analyses can address these issues by providing evidence that the response process does not advantage any particular subgroup of children. DIF analyses can separate performance differences on specific games from individual differences in child ability. Focal and reference categories of children are identified to investigate DIF. We examined the focal group (Spanish) to gather evidence to demonstrate that the games are fair to the members of that particular subgroup. The reference group is typically the majority group (English), and the presumption is that the games are generally fair for the children in that group.

We compared the focal and reference groups by examining their performance in the games after first matching them on their overall ability estimates. Children are, therefore, matched based on the estimated quantity of the ability or developmental level that they are presumed to possess (Walker, 2011). In a Rasch modeling context, DIF can be thought of as differences between members of the focal and reference groups in the conditional probability of a particular response to the games. Evidence of DIF can lead to further investigation of game content, game interpretation by the children, language and translation issues, and even potential game bias. However, it is important to distinguish game bias from game impact. Game impact in the context of this study

refers to true score differences between subgroups of children in their average performance on the games. Game bias in the context of this study means differences between subgroups of children related to construct-irrelevant sources of variance that can lead to inaccurate interpretations of the information that the games can provide. One possible source of construct-irrelevant variance could be the fairness of the content of the games, particularly related to the language of the games (English or Spanish).

Methods

All analyses were confined to the games designed for Levels 1 through 5 within the Ignite educational gaming system. First, the Rasch model, as operationalized through the Winsteps software (Version 4.6.2.1; Linacre, 2020), was used to estimate game difficulty. A separate Rasch analysis was conducted for each of the seven domains of development and learning. Next, the differences between estimated game difficulty for the English and Spanish groups were examined. The following procedures were used to test for the presence of DIF and to examine the magnitude of DIF. The DIF contrast statistic, which is the difference between the paired Rasch item difficulty estimates for each item, was calculated as the simple difference between the item difficulty estimates for the focal and reference groups. Next, Rasch–Welch t tests were examined for statistical significance. These statistics report whether item difficulty estimates for the two groups, across each DIF analysis by game language, are the same except for measurement error. These tests evaluate a null hypothesis that the DIF contrast value is zero against an alternative hypothesis that the DIF contrast is not equal to zero. Next, the Mantel–Haenszel χ^2 statistics produced by the Winsteps software package (Linacre, 2020) were also used to examine evidence of potential DIF. These tests examine a null hypothesis of no DIF by producing a probability of obtaining differences between the focal and reference groups as large as or larger than those obtained, given that there is no DIF. The groups are stratified into matching ability levels, and their relative performance on each item is

quantified. Overall ability estimates for each respondent are estimated based on the total scores on the measure. An alpha level of .05 was used for all comparisons.

In addition to statistical significance testing, examination of the magnitude of the DIF contrast, or the difference in item difficulty estimates between the focal and reference groups, is critical, given the sensitivity of both the Rasch–Welch t test and the Mantel–Haenszel χ^2 to small differences. This is especially important in large sample-size studies, like this one, in which statistical significance is easy to obtain even when the observed differences do not have practical implications. Magnitude of the DIF contrast was determined according to the criteria set forth by Zwick et. al. (1999). If both the t and χ^2 statistics were statistically significant, and the magnitude of the DIF contrast was less than 0.43, the DIF magnitude was considered negligible. If both the t and χ^2 statistics were statistically significant, and the magnitude of the DIF contrast was greater than or equal to 0.43 and less than 0.64, the DIF magnitude was considered intermediate. If both the t and χ^2 statistics were statistically significant, and the magnitude of the DIF contrast was greater than 0.64, the DIF magnitude was considered large.

This study examined the full sample of children who used the Ignite educational gaming system during the 2021–2022 academic year. The sample contained an approximately even percentage of male (50.47%) and female (49.58%) children. The slightly higher percentage of males remained consistent across all the domains of development and learning. The sample contained children who engaged with the English-language (95.57%) and Spanish-language (4.43%) versions of the games. The percentage of children who engaged with the Spanish versions also remained consistent across all domains of learning and development. Table 8 displays the exact counts and percentages of children broken out by gender and user language for each domain of learning and development.

Social Studies Domain

Children who engaged with the Ignite educational gaming system during the 2021–2022 academic year attempted 18 games within the Social Studies domain, each of which had both an English- and a Spanish-language version. The children who attempted the Spanish-language version of these games numbered 2,712, or 4.42% of children who attempted a Social Studies game. The analyses indicated negligible DIF for 15 of the 18 games (83.33%), moderate DIF for one game (5.56%), and large DIF for two games (11.11%). The one game with moderate DIF, game 198, had an initial pass rate of 5.06% in English and 1.70% in Spanish, for a difference of 3.36 percentage points. The two games with large DIF, games 16 and 30, were very difficult and had very small pass rates (passing rate < 0.40%). Therefore, these games demonstrated very small differences in pass rates between the English and Spanish versions.

Table 1 contains the game difficulty estimates for each game in the Social Studies domain by language. Figure 1 displays the DIF results by highlighting the differences in game difficulty. The two lines on this graph are very similar, indicating how close most of the English and Spanish games are in difficulty level. Figure 2 displays the differences in initial pass rates by language. The initial pass rates were higher for the English versions for every game. However, the differences in initial pass rates between the English and Spanish versions were generally small across the Social Studies domain. Nine of the 18 games (50.00%) exhibited a difference in pass rates of less than 5 percentage points. Sixteen of the 18 games (88.89%) exhibited a difference in pass rates of less than 10 percentage points.

Science & Technology Domain

Children who engaged with the Ignite educational gaming system during the 2021–2022 academic year attempted 20 games within the Science & Technology domain, each of which had

both an English- and a Spanish-language version. The children who attempted the Spanish-language version of these games numbered 2,533, or 4.44% of all children who attempted a Science & Technology game. The analyses indicated negligible DIF for 19 of the 20 games (95.00%), moderate DIF for one game (5.00%), and large DIF for none of the games (0.00%). The one game with moderate DIF, game 53, had an initial pass rate of 14.30% in English and 5.53% in Spanish, for a difference of 8.77 percentage points.

Table 2 contains the game difficulty estimates for each game in the Science & Technology domain by language. Figure 3 displays the DIF results by highlighting the differences in game difficulty. The two lines on this graph are very similar, indicating how close most of the English and Spanish games are in difficulty level. Figure 4 displays the differences in initial pass rates by language. Again, the initial pass rates were higher for the English versions for every game. However, the differences in initial pass rates between the English and Spanish versions were generally small across the Science & Technology domain. Eight of the 20 games (40.00%) exhibited a difference in pass rates of less than 5 percentage points. Eighteen of the 20 games (90.00%) exhibited a difference in pass rates of less than 10 percentage points.

Social–Emotional Domain

Children who engaged with the Ignite educational gaming system during the 2021–2022 academic year attempted 26 games within the Social–Emotional domain, each of which had both an English- and a Spanish-language version. The children who attempted the Spanish-language version of these games numbered 2,293, or 4.30% of all children who attempted a Social–Emotional game. The analyses indicated negligible DIF for 25 of the 26 games (96.15%), moderate DIF for none of the games (0.00%), and large DIF for only one of the games (3.85%). The one game with large DIF, game 276, had an initial pass rate of 90.45% in English and 76.19% in Spanish, for a difference of 14.26 percentage points.

Table 3 contains the game difficulty estimates for each game in the Social–Emotional domain by language. Figure 5 displays the DIF results by highlighting the differences in game difficulty. The two lines on this graph are very similar, indicating how close most of the English and Spanish games are in difficulty level. Figure 6 displays the differences in initial pass rates by language. Again, the initial pass rates were higher for the English versions for every game. However, the differences in initial pass rates between the English and Spanish versions were generally small across the Social–Emotional domain. Of the 26 games, 13 (50.00%) exhibited a difference in pass rates of less than 5 percentage points, and 22 (84.62%) exhibited a difference in pass rates of less than 10 percentage points.

Language & Communication Domain

Children who engaged with the Ignite educational gaming system during the 2021–2022 academic year attempted 31 games within the Language & Communication domain, each of which had both an English- and a Spanish-language version. The children who attempted the Spanish-language version of these games numbered 2,767, or 4.54% of all children who attempted a Language & Communication game. The analyses indicated negligible DIF for 28 of the 31 games (90.32%), moderate DIF for two of the games (6.45%), and large DIF for only one of the games (3.23%). The first game that showed moderate DIF, game 35, had an initial pass rate in English of 7.76% and 2.49% in Spanish, for a difference of 5.27 percentage points. The second game that showed moderate DIF, game 159, had an initial pass rate in English of 3.27% and 0.83% in Spanish, for a difference of 2.44 percentage points. The one game with large DIF, game 28, had an initial pass rate of 5.77% in English and 4.26% in Spanish, for a difference of 1.51 percentage points.

Table 4 contains the game difficulty estimates for each game in the Language & Communication domain by English and Spanish. Figure 7 displays the DIF results by highlighting the differences in game difficulty. The two lines on this graph are very similar, indicating how close

most of the English and Spanish games are in difficulty level. Figure 8 displays the differences in initial pass rates by language. Again, the initial pass rates were higher for the English versions for every game. However, the differences in initial pass rates between the English and Spanish versions were generally small across the Language & Communication domain. Of the 31 games, 20 (64.52%) exhibited a difference in pass rates of less than 5 percentage points, and 27 (87.10%) exhibited a difference in pass rates of less than 10 percentage points.

Physical Domain

Children who engaged with the Ignite educational gaming system during the 2021–2022 academic year attempted 16 games within the Physical domain, each of which had both an English- and a Spanish-language version. The children who attempted the Spanish-language version of these games numbered 2,660, or 4.46% of all children who attempted a Physical game. The analyses indicated negligible DIF for 11 of the 16 games (68.75%), moderate DIF for five of the games (31.25%), and large DIF for none of the games (0.00%). The five games that showed moderate DIF, games 17, 114, 32, 196, and 199, showed differences in initial pass rates that ranged from as little as 0.30 percentage points (game 17) to as high as 6.34 percentage points (game 114).

Table 5 contains the game difficulty estimates for each game in the Physical domain by English and Spanish. Figure 9 displays the DIF results by highlighting the differences in game difficulty. The two lines on this graph are very similar, indicating how close most of the English and Spanish games are in difficulty level. Figure 10 displays the differences in initial pass rates by language. Again, the initial pass rates were higher for the English versions for every game. However, the differences in initial pass rates between the English and Spanish versions were generally small across the Physical domain. Of the 16 games, 12 (75.00%) exhibited a difference in pass rates of less than 5 percentage points. All 16 games (100.00%) exhibited a difference in pass rates of less than 10 percentage points.

Mathematics Domain

Children who engaged with the Ignite educational gaming system during the 2021–2022 academic year attempted 64 games within the Mathematics domain, each of which had both an English- and a Spanish-language version. The children who attempted the Spanish-language version of these games numbered 2,576, or 4.40% of all children who attempted a Mathematics game. The analyses indicated negligible DIF for 56 of the 64 games (87.50%), moderate DIF for four of the games (6.25%), and large DIF for four of the games (6.25%). The four games that showed moderate DIF, games 184, 104, 141, and 235, showed differences in initial pass rates that ranged from as little as 0.24 percentage points (game 235) to as high as 8.92 percentage points (game 184). The four games that showed large DIF, games 110, 129, 143, and 182, showed differences in initial pass rates that ranged from as little as 0.72 percentage points (game 182) to as high as 8.42 percentage points (game 110).

Table 6 contains the game difficulty estimates for each game in the Mathematics domain by English and Spanish. Figure 11 displays the DIF results by highlighting the differences in game difficulty. The two lines on this graph are very similar, indicating how close most of the English and Spanish games are in difficulty level. Figure 12 displays the differences in initial pass rates by language. Again, the initial pass rates were higher for the English versions for every game. However, the differences in initial pass rates between the English and Spanish versions were generally small across the Mathematics domain. Of the 64 games, 34 (53.13%) exhibited a difference in pass rates of less than 5 percentage points, and 58 (90.63%) exhibited a difference in pass rates of less than 10 percentage points.

Literacy Domain

Children who engaged with the Ignite educational gaming system during the 2021–2022 academic year attempted 63 games within the Literacy domain, each of which had both an English-

and a Spanish-language version. The children who attempted the Spanish-language version of these games numbered 2,758, or 4.43% of all children who attempted a Literacy game. The analyses indicated negligible DIF for 45 of the 63 games (71.43%), moderate DIF for nine of the games (14.29%), and large DIF for nine of the games (14.29%). Therefore, the analyses detected DIF within a substantially higher percentage of the Literacy games than in any other domain games. The nine games that showed moderate DIF, games 19, 82, 39, 102, 253, 52, 73, 103 and 146, showed differences in initial pass rates that ranged from as little as 0.82 percentage points (game 103) to as high as 6.67 percentage points (game 19). The nine games that showed large DIF, games 71, 248, 59, 13, 46, 23, 49, 109, and 85, showed differences in initial pass rates that ranged from as little as 0.19 percentage points (game 85) to as high as 12.33 percentage points (game 248).

Table 7 contains the game difficulty estimates for each game in the Literacy domain by English and Spanish. Figure 13 displays the DIF results by highlighting the differences in game difficulty. The two lines on this graph are very similar, indicating how close most of the English and Spanish games are in difficulty level. Figure 14 displays the differences in initial pass rates by language. The initial pass rates were higher for most of the English versions of the games. However, the initial pass rates were almost identical for three of the games, which actually showed a slight advantage for the Spanish versions. The differences in initial pass rates between the English and Spanish versions were generally small across the Literacy domain. Of the 63 games, 43 (68.25%) exhibited a difference in pass rates of less than 5 percentage points, and 55 (87.30%) exhibited a difference in pass rates of less than 10 percentage points.

Summary

Of the 238 games investigated across the seven domains of development and learning, the analyses demonstrated negligible DIF for 199 games (83.61%). The analyses revealed evidence of moderate DIF for 22 of the games (9.24%) and large DIF for 17 of the games (7.14%). The

differences in initial pass rates between the English and Spanish versions were generally small across all domains. Of the 238 games, 139 (58.40%) exhibited a difference in pass rates between the English- and Spanish-language versions of less than 5 percentage points, and 212 (89.08%) exhibited a difference in pass rates of less than 10 percentage points.

These results are generally favorable and indicate a relatively small number of games with DIF, or potential for bias by game language. However, the games in which DIF was detected should be monitored in the future and investigated, particularly those in which large DIF was detected. These results may indicate structural issues that favor English-speaking children or issues with the language translation within the games. Particular attention should be paid to the games within the Literacy domain, where the analyses identified a higher percentage of games with moderate or large DIF.

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Table 1

Social Studies Game Difficulty and Pass Rates by Language

Game ID	Game difficulty			Pass rates		
	English	Spanish	Difference	English	Spanish	Difference
1	-9.91	-10.07	0.16	92.58	91.41	1.17
40	-7.51	-7.39	-0.13	73.77	65.23	8.54
202	-5.87	-5.75	-0.13	59.42	49.23	10.19
148	-5.41	-5.41	0.00	55.40	46.17	9.23
69	-4.53	-4.45	-0.09	47.89	37.79	10.10
22	-2.01	-2.33	0.32	27.52	21.17	6.35
168	-1.46	-1.50	0.05	24.50	16.67	7.83
60	-1.19	-1.26	0.07	23.17	15.56	7.61
175	-0.54	-0.41	-0.13	20.23	12.24	7.99
108	0.45	0.78	-0.33	16.22	8.55	7.67
97	2.11	1.87	0.24	10.44	6.01	4.43
177	2.44	2.29	0.15	9.54	5.24	4.30
178	2.52	2.35	0.17	9.32	5.13	4.19
135	3.20	3.32	-0.12	7.70	3.65	4.05
198	4.55	5.13	-0.57	5.06	1.70	3.36
193	4.72	4.34	0.39	4.73	2.43	2.30
16	9.20	7.99	1.22	0.37	0.29	0.08
30	9.32	8.34	0.98	0.34	0.22	0.12

Table 2
Science & Technology Game Difficulty and Pass Rates by Language

Game ID	Game difficulty			Pass rates		
	English	Spanish	Difference	English	Spanish	Difference
48	-4.41	-4.41	0.00	70.42	60.17	10.25
37	-2.62	-2.42	-0.19	45.20	30.95	14.25
2	-2.52	-2.76	0.24	43.48	35.73	7.75
25	-1.62	-1.72	0.10	30.97	21.99	8.98
72	-1.01	-0.94	-0.07	23.78	14.17	9.61
62	-0.75	-0.85	0.10	21.00	13.46	7.54
29	-0.67	-0.77	0.11	20.15	12.83	7.32
112	-0.27	-0.02	-0.24	16.61	7.97	8.64
95	-0.20	-0.27	0.07	15.97	9.40	6.57
43	-0.17	0.00	-0.17	15.77	7.86	7.91
42	-0.07	-0.19	0.12	14.94	8.92	6.02
53	0.03	0.52	-0.49	14.30	5.53	8.77
93	0.56	0.46	0.10	10.50	5.72	4.78
154	0.74	0.71	0.03	9.45	4.82	4.63
187	1.17	0.98	0.19	7.25	3.95	3.30
134	1.80	1.62	0.18	4.76	2.41	2.35
127	1.87	1.96	-0.09	4.55	1.82	2.73
81	1.95	2.04	-0.09	4.30	1.70	2.60
195	2.42	2.58	-0.16	3.05	1.07	1.98
161	3.75	3.66	0.09	1.06	0.39	0.67

Table 3

Social–Emotional Game Difficulty and Pass Rates by Language

Game ID	Game difficulty			Pass rates		
	English	Spanish	Difference	English	Spanish	Difference
276	-6.98	-6.24	-0.74	90.45	76.19	14.26
277	-4.18	-3.96	-0.22	63.95	47.75	16.20
3	-3.55	-3.69	0.14	55.59	44.09	11.50
286	-2.12	-1.96	-0.16	36.98	23.33	13.65
9	-1.54	-1.93	0.39	29.69	23.07	6.62
99	-1.43	-1.69	0.27	28.47	20.72	7.75
287	-1.30	-1.43	0.14	27.09	18.36	8.73
278	-1.07	-1.20	0.13	24.70	16.35	8.35
66	-0.52	-0.77	0.25	19.34	13.13	6.21
279	-0.32	-0.32	0.00	17.69	10.16	7.53
123	-0.09	-0.19	0.09	15.85	9.51	6.34
280	-0.06	0.00	-0.06	15.64	8.55	7.09
76	0.31	0.58	-0.26	12.95	5.97	6.98
170	0.59	0.51	0.08	11.11	6.24	4.87
289	0.87	0.95	-0.08	9.49	4.67	4.82
290	1.13	1.16	-0.02	8.11	4.06	4.05
288	1.28	1.01	0.27	7.36	4.49	2.87
291	1.41	1.32	0.09	6.83	3.62	3.21
118	1.45	1.32	0.13	6.66	3.62	3.04
201	1.62	1.81	-0.19	5.99	2.53	3.46
139	1.69	2.00	-0.31	5.72	2.18	3.54
281	1.89	2.00	-0.11	4.98	2.18	2.80
292	2.12	1.98	0.14	4.24	2.22	2.02
293	2.23	2.26	-0.03	3.93	1.79	2.14
304	2.98	3.24	-0.26	2.25	0.79	1.46
305	3.53	3.80	-0.27	1.45	0.48	0.97

Table 4

Language & Communication Game Difficulty and Pass Rates by Language

Game ID	Game difficulty			Pass rates		
	English	Spanish	Difference	English	Spanish	Difference
4	-6.83	-6.99	0.16	88.02	83.74	4.28
16	-4.35	-4.35	0.00	60.45	49.22	11.23
14	-4.13	-3.98	-0.15	57.30	43.15	14.15
7	-2.84	-2.51	-0.33	38.70	23.20	15.50
21	-2.76	-2.93	0.18	37.27	28.33	8.94
24	-1.83	-1.75	-0.08	25.99	15.68	10.31
30	-1.19	-1.43	0.24	19.43	13.16	6.27
36	-0.82	-1.15	0.33	16.26	11.17	5.09
57	-0.74	-0.68	-0.06	15.80	8.42	7.38
41	-0.53	-0.53	0.00	14.22	7.66	6.56
50	-0.44	-0.48	0.04	13.52	7.41	6.11
272	0.25	0.22	0.02	9.38	4.66	4.72
78	0.45	0.21	0.24	8.34	4.70	3.64
181	0.54	0.43	0.11	7.95	4.05	3.90
55	0.57	0.34	0.23	7.78	4.30	3.48
35	0.59	1.09	-0.50	7.76	2.49	5.27
64	0.88	1.27	-0.40	6.54	2.17	4.37
130	0.90	0.96	-0.06	6.43	2.75	3.68
273	0.91	1.21	-0.30	6.40	2.28	4.12
28	1.05	0.35	0.70	5.77	4.26	1.51
263	1.40	1.34	0.06	4.66	2.06	2.60
265	1.46	1.36	0.09	4.49	2.02	2.47
274	1.47	1.82	-0.34	4.48	1.41	3.07
67	1.68	1.88	-0.20	3.90	1.34	2.56
66	1.70	1.79	-0.09	3.83	1.45	2.38
111	1.91	1.91	0.00	3.30	1.30	2.00
159	1.93	2.44	-0.51	3.27	0.83	2.44
192	1.94	1.85	0.09	3.22	1.37	1.85
268	2.07	2.30	-0.23	2.95	0.94	2.01
267	2.20	2.13	0.07	2.67	1.08	1.59
264	2.57	2.60	-0.03	2.03	0.72	1.31

Table 5

Physical Game Difficulty and Pass Rates by Language

Game ID	Game difficulty			Pass rates		
	English	Spanish	Difference	English	Spanish	Difference
5	-3.27	-3.31	0.04	51.60	46.39	5.21
45	-3.02	-3.08	0.06	47.89	42.89	5.00
10	-1.84	-1.87	0.03	31.04	25.11	5.93
17	-1.66	-2.12	0.46	28.76	28.46	0.30
74	-0.74	-0.58	-0.16	18.70	11.99	6.71
68	-0.73	-0.50	-0.23	18.63	11.35	7.28
105	0.31	0.40	-0.10	10.61	6.20	4.41
119	0.33	0.59	-0.27	10.53	5.41	5.12
114	0.32	0.95	-0.63	10.51	4.17	6.34
84	0.73	0.63	0.10	8.23	5.26	2.97
32	0.78	0.28	0.50	7.87	6.77	1.10
196	1.04	1.47	-0.43	6.85	2.78	4.07
137	1.27	1.34	-0.07	5.84	3.08	2.76
190	1.31	1.67	-0.36	5.73	2.37	3.36
199	1.51	1.95	-0.44	5.02	1.88	3.14
179	3.66	3.55	0.11	0.95	0.45	0.50

Table 6
Mathematics Game Difficulty and Pass Rates by Language

Game ID	Game difficulty			Pass rates		
	English	Spanish	Difference	English	Spanish	Difference
65	-3.75	-4.01	0.26	52.08	45.69	6.39
56	-3.66	-3.62	-0.05	51.12	39.98	11.14
231	-3.32	-3.12	-0.20	46.31	32.88	13.43
246	-3.14	-3.10	-0.04	43.62	32.65	10.97
26	-2.94	-2.55	-0.39	40.97	25.47	15.50
117	-2.85	-3.01	0.16	39.40	31.37	8.03
107	-2.55	-2.74	0.19	35.22	27.80	7.42
98	-2.49	-2.72	0.22	34.50	27.56	6.94
20	-2.33	-2.69	0.37	32.21	27.25	4.96
169	-2.32	-2.05	-0.27	32.46	19.72	12.74
101	-2.23	-2.36	0.14	31.06	23.21	7.85
18	-2.18	-2.33	0.15	30.46	22.79	7.67
113	-1.89	-1.81	-0.08	27.06	17.31	9.75
133	-1.78	-1.78	0.00	25.69	16.96	8.73
247	-1.73	-1.65	-0.08	25.14	15.76	9.38
153	-1.53	-1.21	-0.32	23.02	12.11	10.91
31	-1.42	-1.48	0.05	21.72	14.25	7.47
54	-1.32	-1.24	-0.08	20.68	12.31	8.37
120	-1.32	-1.55	0.23	20.52	14.87	5.65
233	-1.10	-0.96	-0.14	18.52	10.29	8.23
228	-1.07	-1.07	0.00	18.18	11.10	7.08
51	-1.00	-1.10	0.10	17.49	11.26	6.23
232	-0.69	-0.67	-0.02	14.85	8.50	6.35
184	-0.65	-0.10	-0.55	14.63	5.71	8.92
34	-0.53	-0.82	0.28	13.53	9.39	4.14
38	-0.53	-0.46	-0.06	13.57	7.38	6.19
162	-0.52	-0.57	0.05	13.45	7.92	5.53
138	-0.48	-0.70	0.22	13.14	8.66	4.48
110	-0.32	0.52	-0.84	11.99	3.57	8.42
126	-0.28	-0.32	0.04	11.72	6.68	5.04
176	-0.23	-0.07	-0.16	11.44	5.59	5.85
90	-0.12	0.12	-0.24	10.74	4.85	5.89

Game ID	Game difficulty			Pass rates		
	English	Spanish	Difference	English	Spanish	Difference
183	-0.07	-0.12	0.05	10.32	5.78	4.54
229	0.04	-0.13	0.17	9.66	5.82	3.84
167	0.04	0.21	-0.17	9.69	4.54	5.15
79	0.25	-0.02	0.26	8.44	5.36	3.08
236	0.31	0.14	0.17	8.11	4.77	3.34
94	0.33	0.67	-0.34	8.08	3.18	4.90
157	0.66	0.49	0.16	6.46	3.65	2.81
186	0.69	0.69	0.00	6.34	3.18	3.16
129	0.83	1.68	-0.85	5.75	1.40	4.35
63	0.91	0.89	0.02	5.45	2.68	2.77
61	1.04	1.04	0.00	4.97	2.41	2.56
104	1.08	0.55	0.53	4.78	3.49	1.29
234	1.24	1.02	0.22	4.29	2.41	1.88
100	1.30	1.39	-0.08	4.11	1.79	2.32
230	1.53	1.64	-0.11	3.48	1.44	2.04
174	1.67	1.44	0.23	3.12	1.71	1.41
191	1.80	1.68	0.13	2.81	1.40	1.41
150	2.03	2.14	-0.11	2.37	0.93	1.44
238	2.09	2.01	0.08	2.26	1.05	1.21
124	2.15	2.53	-0.38	2.16	0.66	1.50
143	2.19	3.50	-1.30	2.07	0.27	1.80
96	2.23	2.41	-0.18	2.02	0.74	1.28
141	2.36	2.83	-0.47	1.83	0.50	1.33
86	2.44	2.19	0.24	1.69	0.89	0.80
160	2.54	2.67	-0.13	1.57	0.58	0.99
194	2.62	2.47	0.15	1.46	0.70	0.76
131	2.62	2.53	0.09	1.46	0.66	0.80
237	2.68	2.53	0.15	1.39	0.66	0.73
158	2.77	2.35	0.42	1.28	0.78	0.50
164	3.07	2.92	0.16	0.99	0.47	0.52
182	3.29	4.38	-1.09	0.84	0.12	0.72
235	3.46	2.92	0.54	0.71	0.47	0.24

Table 7
Literacy Game Difficulty and Pass Rates by Language

Game ID	Game difficulty			Pass rates		
	English	Spanish	Difference	English	Spanish	Difference
71	-9.16	-8.24	-0.93	92.72	81.18	11.54
248	-8.39	-7.70	-0.68	88.36	76.03	12.33
11	-6.03	-6.38	0.35	68.46	61.57	6.89
249	-6.00	-5.71	-0.29	68.53	54.02	14.51
92	-5.61	-5.68	0.07	64.40	53.63	10.77
89	-5.42	-5.13	-0.29	62.59	47.35	15.24
19	-5.03	-5.50	0.47	58.27	51.60	6.67
189	-3.74	-3.54	-0.19	43.68	30.17	13.51
240	-3.04	-2.95	-0.09	35.80	24.47	11.33
250	-2.91	-2.85	-0.06	34.34	23.57	10.77
70	-2.45	-2.69	0.24	29.38	22.08	7.30
116	-2.17	-2.17	0.00	26.73	17.91	8.82
125	-1.38	-1.22	-0.16	19.65	11.35	8.30
142	-1.06	-0.89	-0.17	17.10	9.54	7.56
152	-0.97	-0.91	-0.06	16.43	9.64	6.79
59	-0.91	-1.96	1.06	15.95	16.24	-0.29
91	-0.81	-0.88	0.07	15.28	9.50	5.78
8	-0.64	-0.71	0.06	14.11	8.63	5.48
13	-0.27	-1.31	1.04	11.76	11.89	-0.13
106	-0.19	-0.17	-0.02	11.29	6.31	4.98
149	-0.19	-0.47	0.28	11.21	7.54	3.67
203	-0.17	-0.02	-0.14	11.16	5.77	5.39
251	-0.03	0.05	-0.08	10.38	5.51	4.87
82	0.06	-0.47	0.53	9.80	7.54	2.26
83	0.10	0.43	-0.33	9.74	4.31	5.43
46	0.10	1.35	-1.25	9.66	2.25	7.41
156	0.32	0.25	0.07	8.59	4.86	3.73
33	0.37	0.02	0.35	8.27	5.62	2.65
87	0.43	0.47	-0.03	8.05	4.21	3.84
252	0.48	0.53	-0.05	7.83	4.02	3.81
165	0.54	0.75	-0.21	7.60	3.48	4.12
39	0.71	0.14	0.57	6.79	5.22	1.57

Game ID	Game difficulty			Pass rates		
	English	Spanish	Difference	English	Spanish	Difference
171	0.88	1.04	-0.16	6.18	2.83	3.35
185	1.12	1.33	-0.21	5.35	2.28	3.07
75	1.18	0.79	0.38	5.10	3.37	1.73
102	1.19	1.71	-0.52	5.12	1.70	3.42
163	1.27	1.31	-0.04	4.85	2.32	2.53
197	1.28	1.33	-0.05	4.81	2.28	2.53
23	1.31	0.43	0.88	4.68	4.31	0.37
121	1.44	1.46	-0.02	4.32	2.07	2.25
253	1.50	2.04	-0.54	4.19	1.31	2.88
115	1.66	1.25	0.41	3.70	2.43	1.27
52	1.75	2.26	-0.51	3.53	1.09	2.44
49	1.91	2.73	-0.82	3.15	0.73	2.42
172	1.93	2.18	-0.25	3.09	1.16	1.93
44	1.95	1.97	-0.02	3.04	1.38	1.66
58	2.04	2.26	-0.22	2.85	1.09	1.76
73	2.06	1.56	0.50	2.79	1.92	0.87
103	2.06	1.53	0.53	2.78	1.96	0.82
244	2.07	2.34	-0.27	2.80	1.02	1.78
245	2.20	2.34	-0.14	2.55	1.02	1.53
180	2.25	2.62	-0.37	2.45	0.80	1.65
122	2.36	2.62	-0.26	2.25	0.80	1.45
146	2.37	2.91	-0.54	2.25	0.62	1.63
255	2.48	2.62	-0.14	2.06	0.80	1.26
109	2.76	1.17	1.59	1.64	2.57	-0.93
254	2.75	2.57	0.18	1.66	0.83	0.83
27	2.77	2.79	-0.02	1.64	0.69	0.95
241	2.79	2.98	-0.19	1.61	0.58	1.03
80	2.81	3.21	-0.41	1.60	0.47	1.13
173	2.82	2.98	-0.16	1.58	0.58	1.00
88	3.08	3.30	-0.21	1.28	0.44	0.84
85	3.46	2.73	0.73	0.92	0.73	0.19

Table 8
Child Demographics by Domain

Domain	User language		Gender	
	English	Spanish	Male	Female
Social Studies	58,652 95.58%	2,712 4.42%	29,213 50.43%	28,716 49.57%
Science & Technology	54,538 95.56%	2,533 4.44%	27,044 50.19%	26,838 49.81%
Social-Emotional	51,045 95.70%	2,293 4.30%	25,251 50.16%	25,086 49.84%
Language & Communication	58,174 95.46%	2,767 4.54%	28,960 50.40%	28,500 49.60%
Physical	56,946 95.54%	2,660 4.46%	28,357 50.38%	27,929 49.62%
Mathematics	56,000 95.60%	2,576 4.40%	27,685 50.13%	27,539 49.87%
Literacy	59,483 95.57%	2,758 4.43%	29,561 50.37%	29,131 49.63%

Figure 1

Differential Item Functioning (DIF) Results: Social Studies (1 = English, 2 = Spanish)

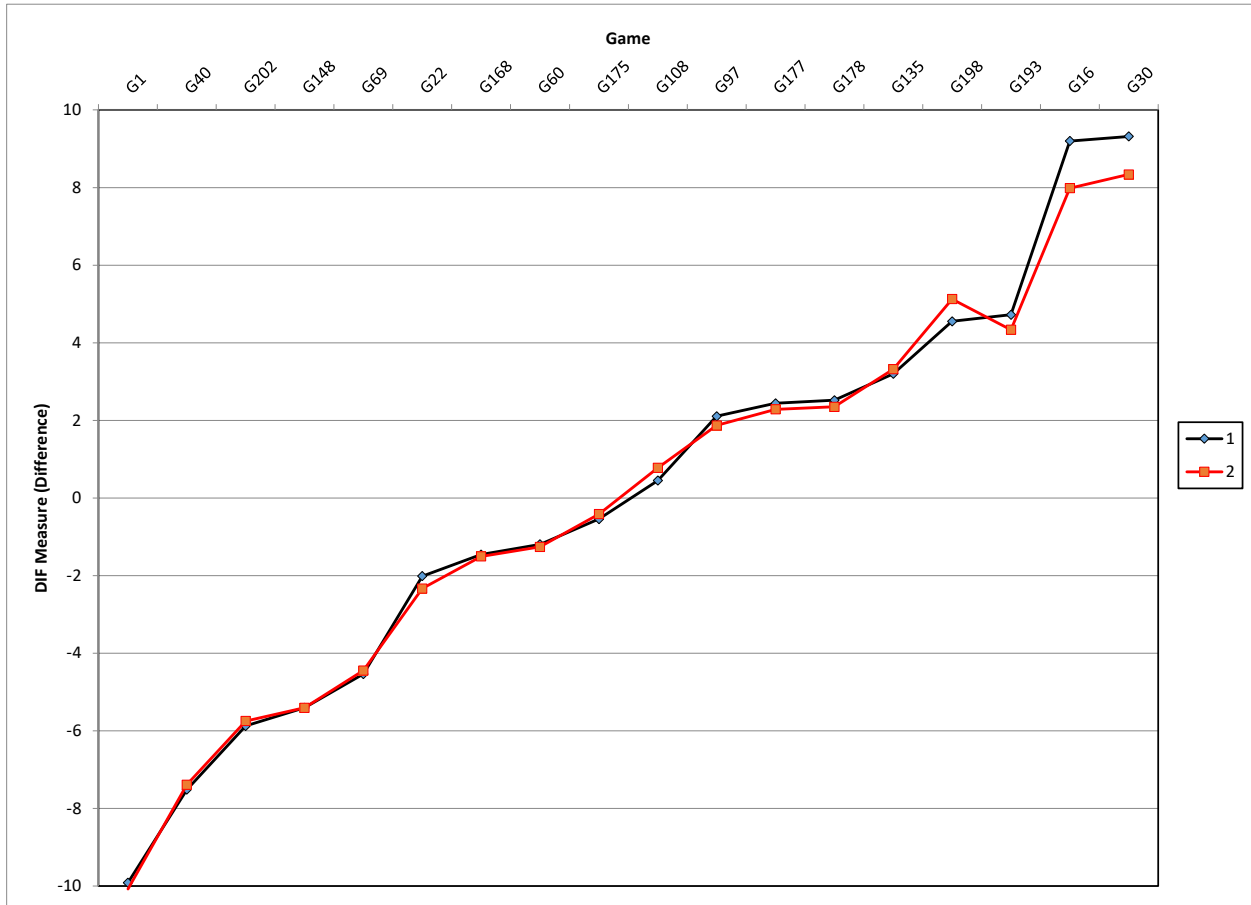


Figure 2

Pass Rates: Social Studies (1 = English, 2 = Spanish)

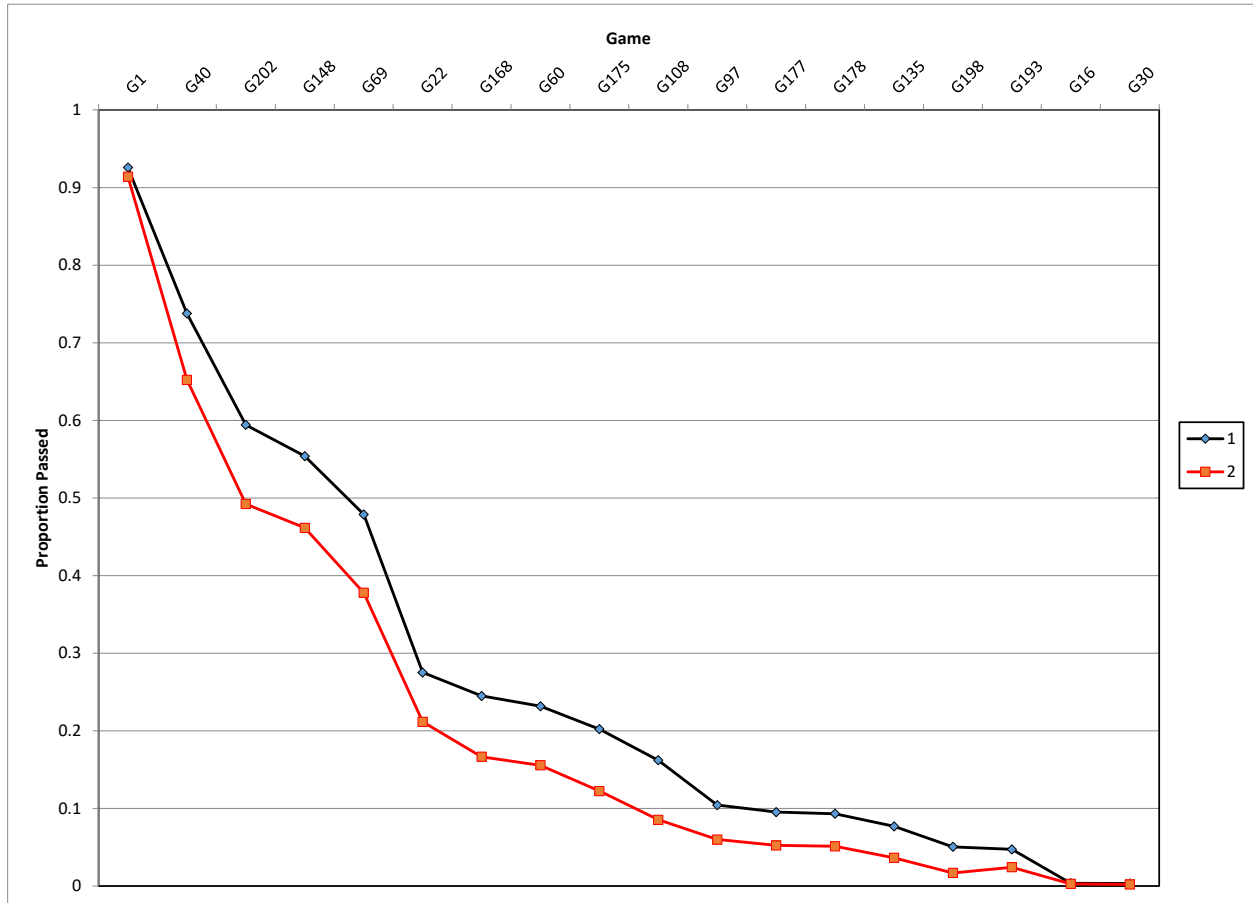


Figure 3

Differential Item Functioning (DIF) Results: Science & Technology (1 = English, 2 = Spanish)

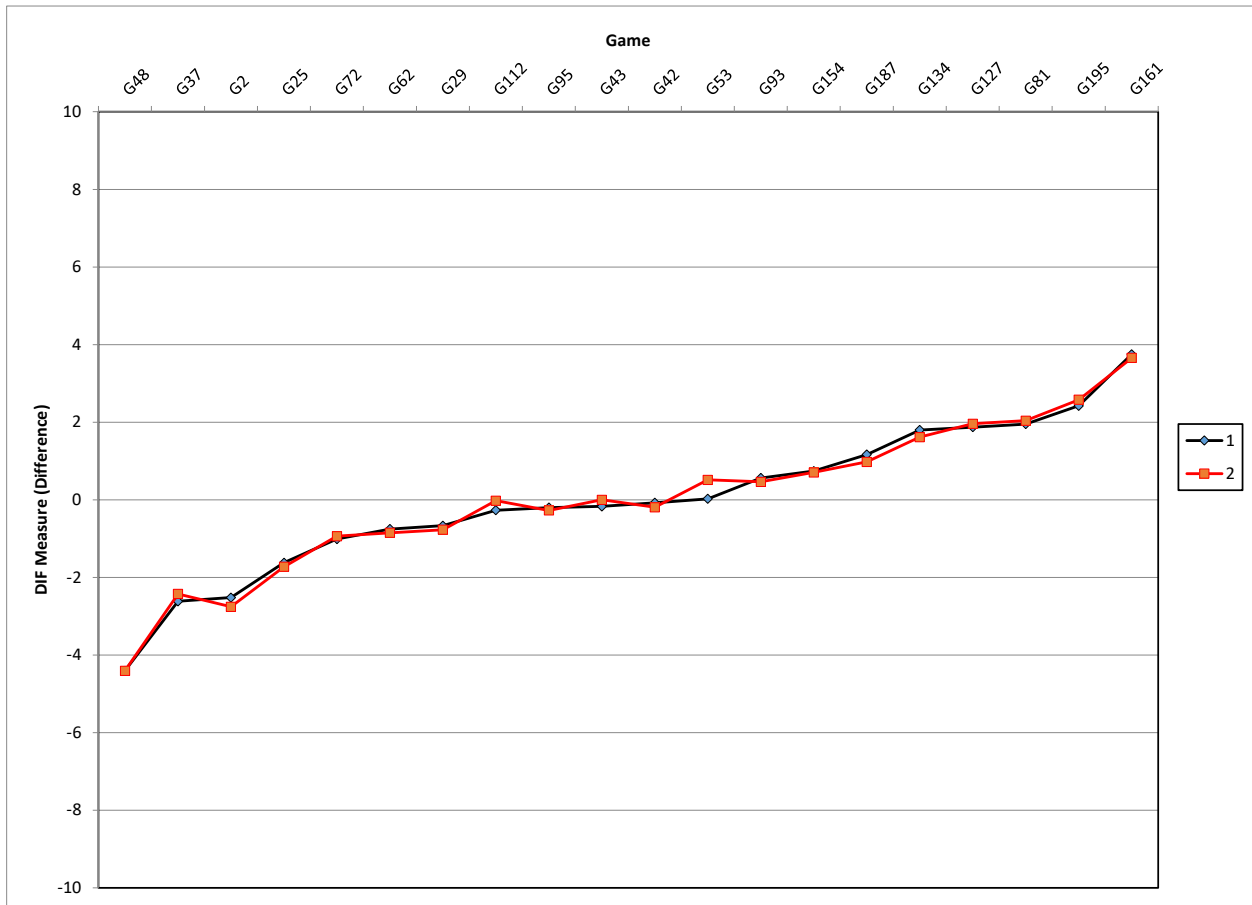


Figure 4

Pass Rates: Science & Technology (1 = English, 2 = Spanish)

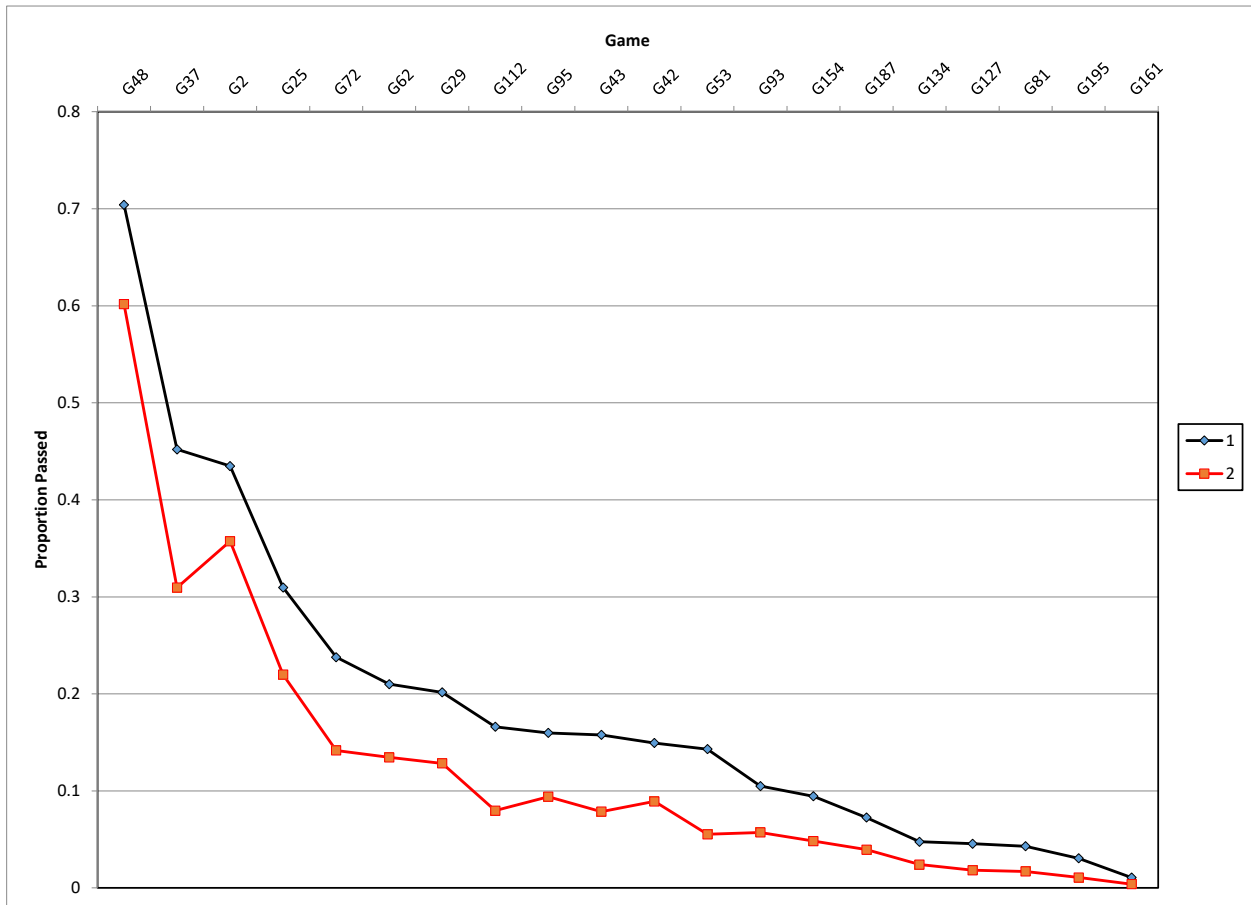


Figure 5

Differential Item Functioning (DIF) Results: Social-Emotional (1 = English, 2 = Spanish)

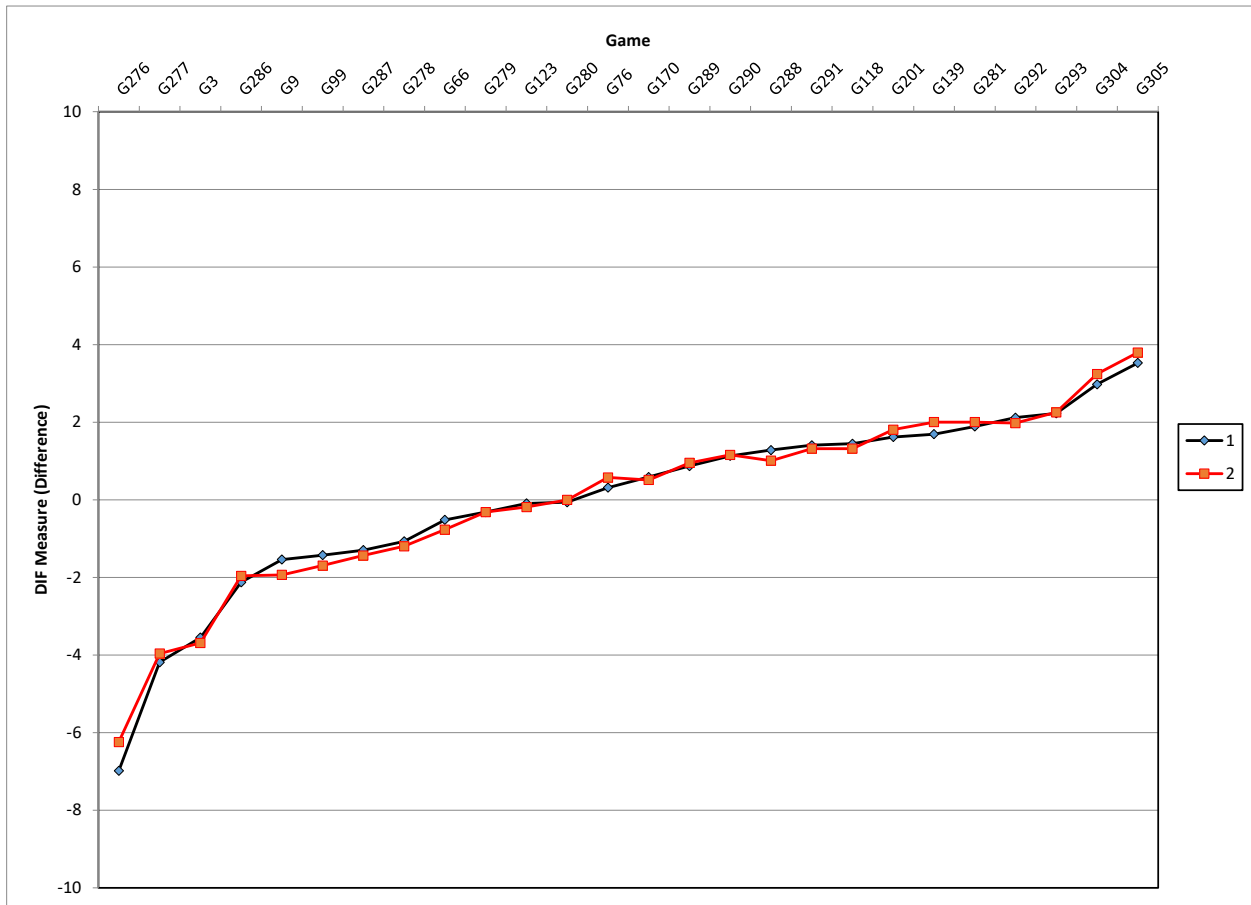


Figure 6

Passing Rates: Social-Emotional (1 = English, 2 = Spanish)

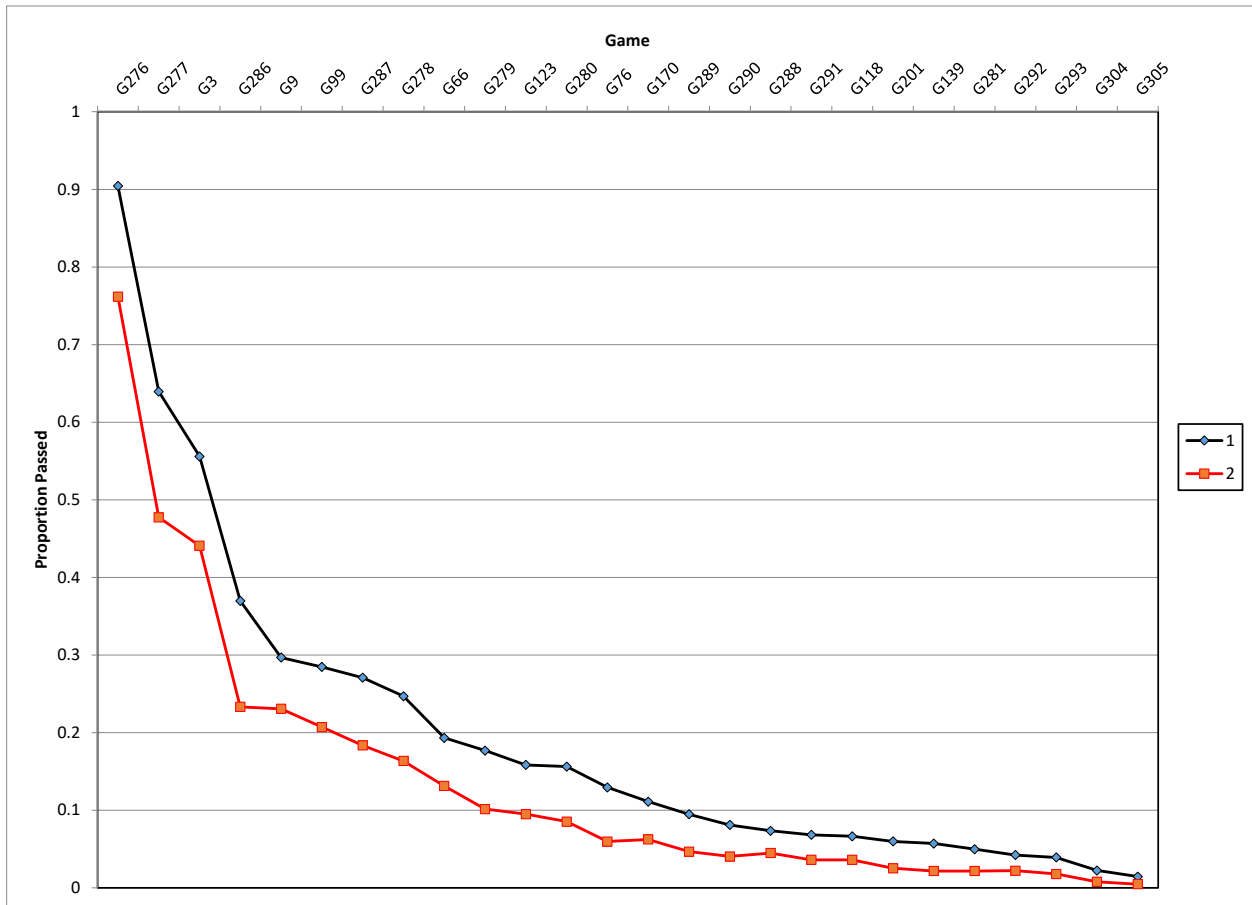


Figure 7

Differential Item Functioning (DIF) Results: Language & Communication (1 = English, 2 = Spanish)

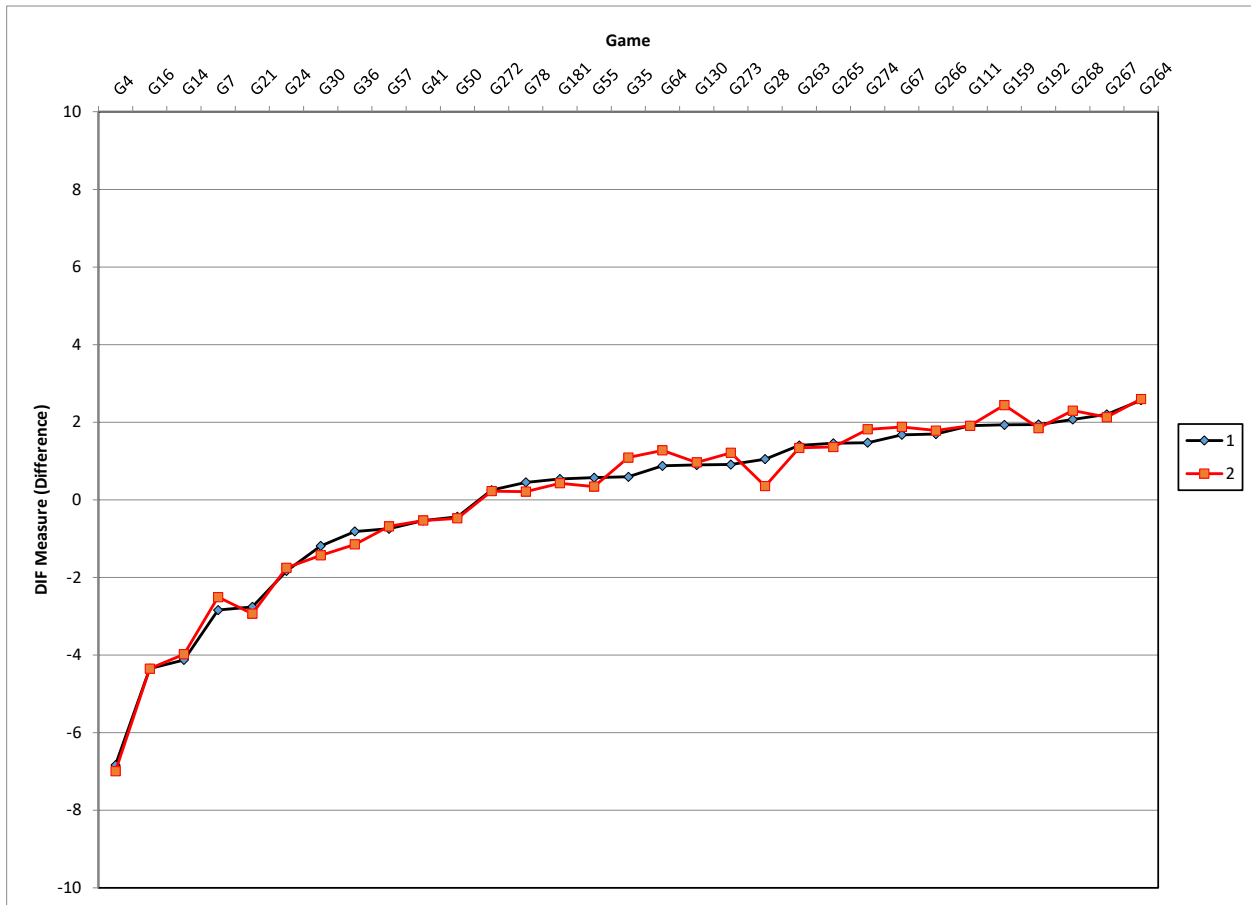


Figure 8

Passing Rates: Language & Communication (1 = English, 2 = Spanish)

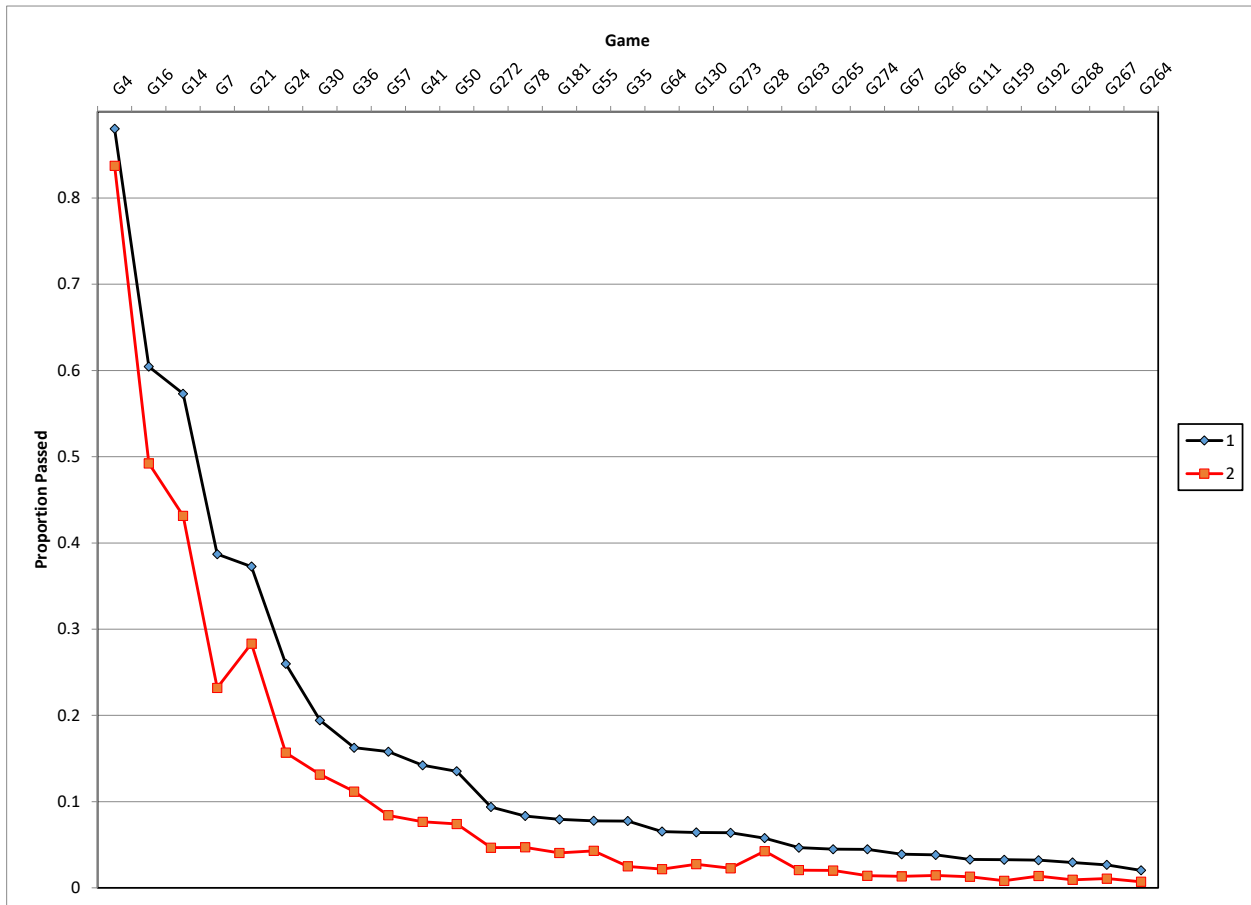


Figure 9

Differential Item Functioning (DIF) Results: Physical (1 = English, 2 = Spanish)

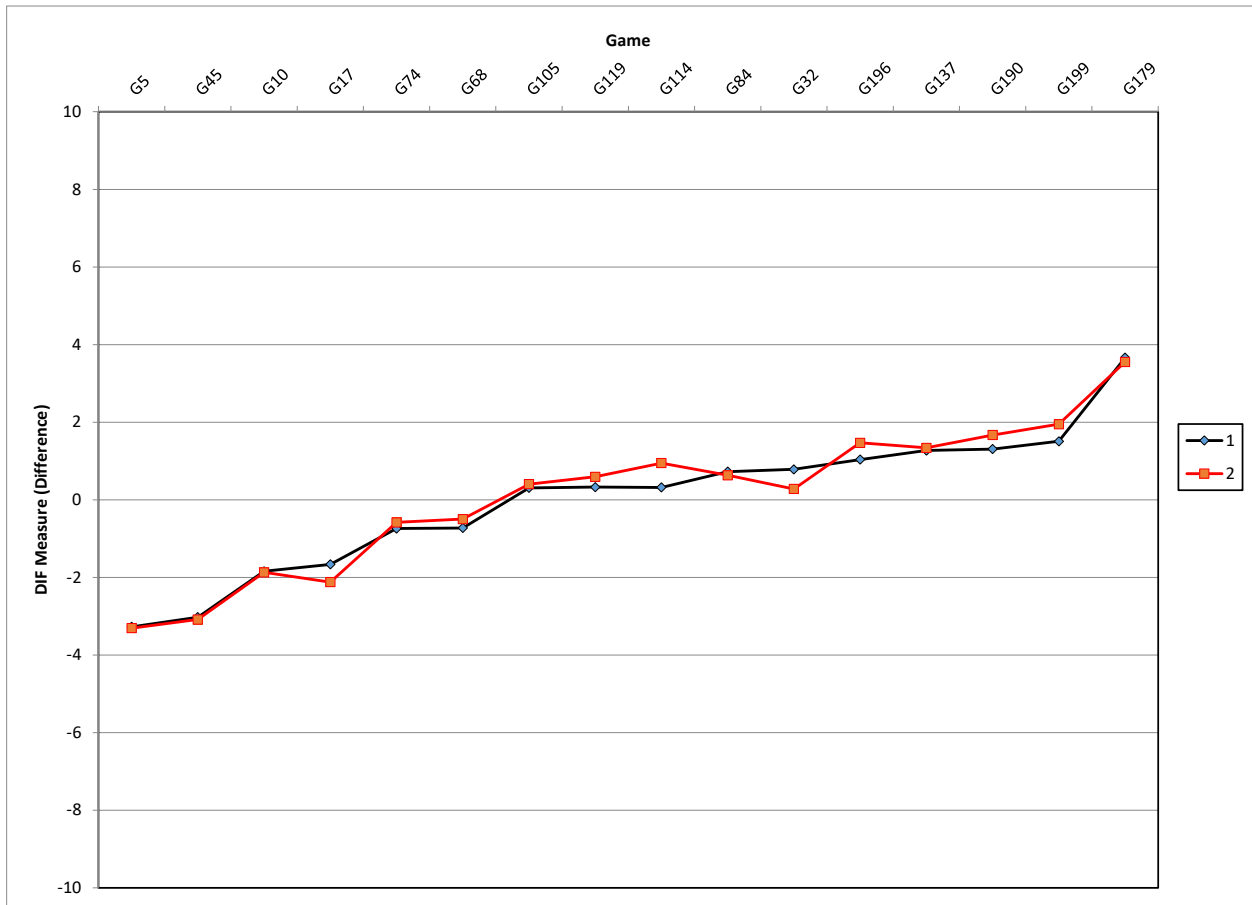


Figure 10

Passing Rates: Physical (1 = English, 2 = Spanish)

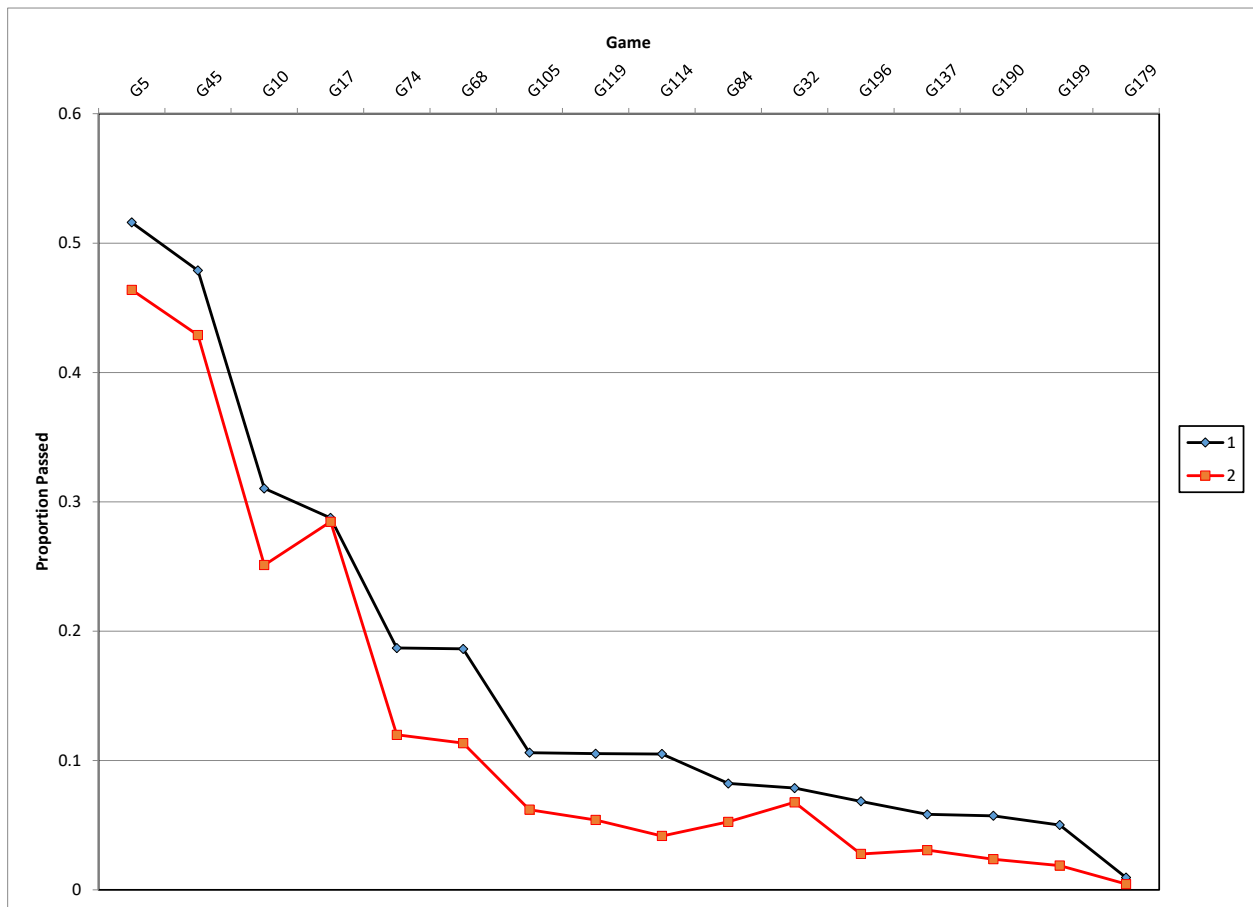


Figure 11

Differential Item Functioning (DIF) Results: Mathematics (1 = English, 2 = Spanish)

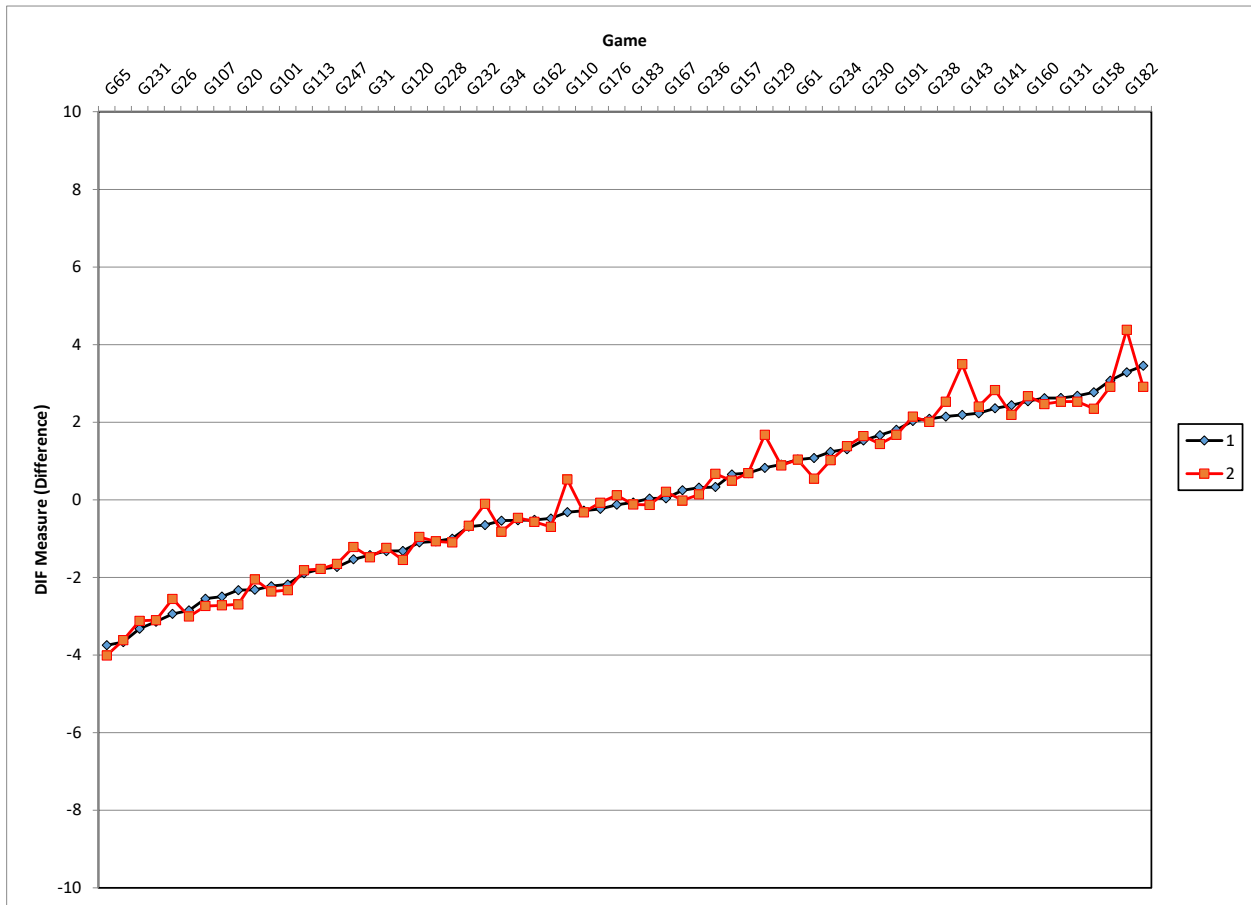


Figure 12

Passing Rates: Mathematics (1 = English, 2 = Spanish)

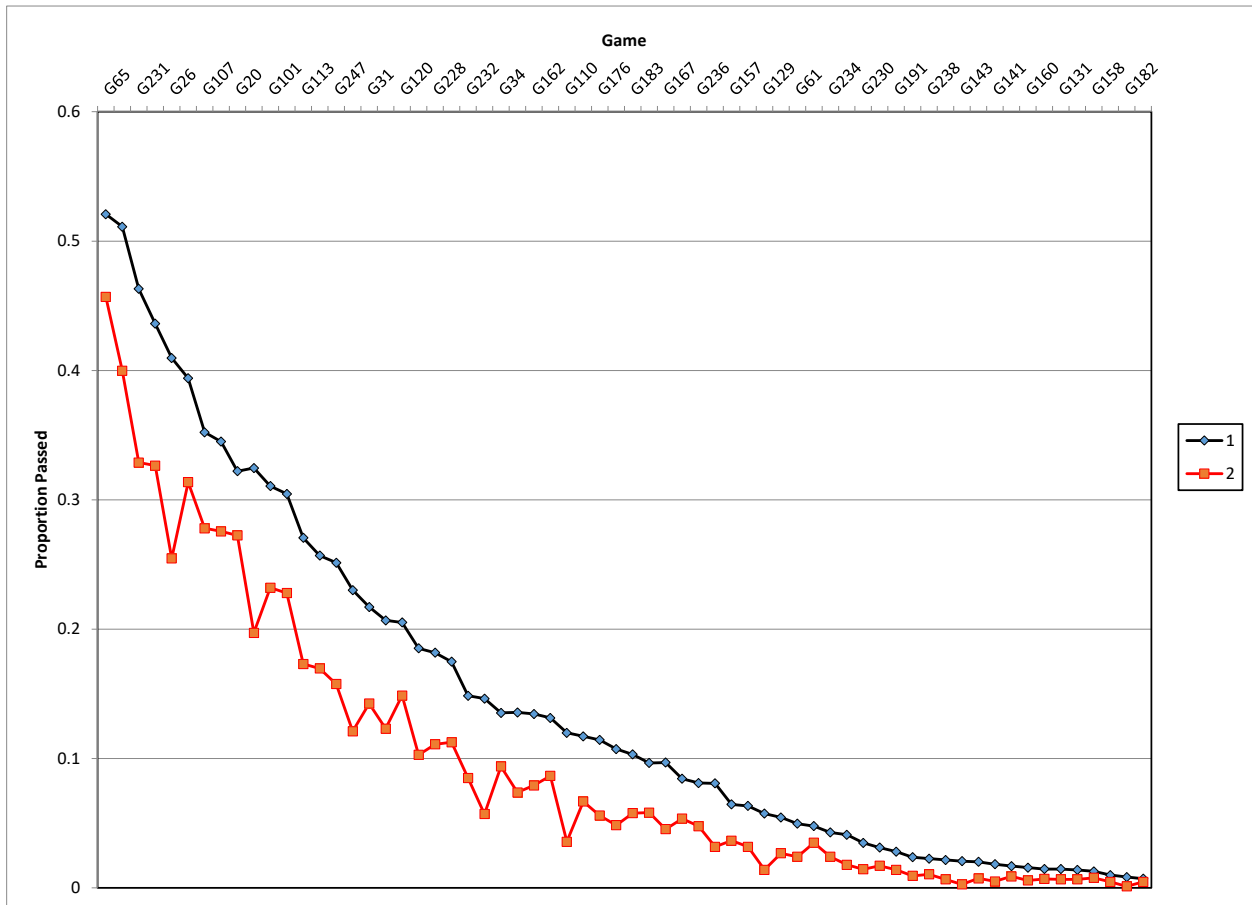


Figure 13

Differential Item Functioning (DIF) Results: Literacy (1 = English, 2 = Spanish)

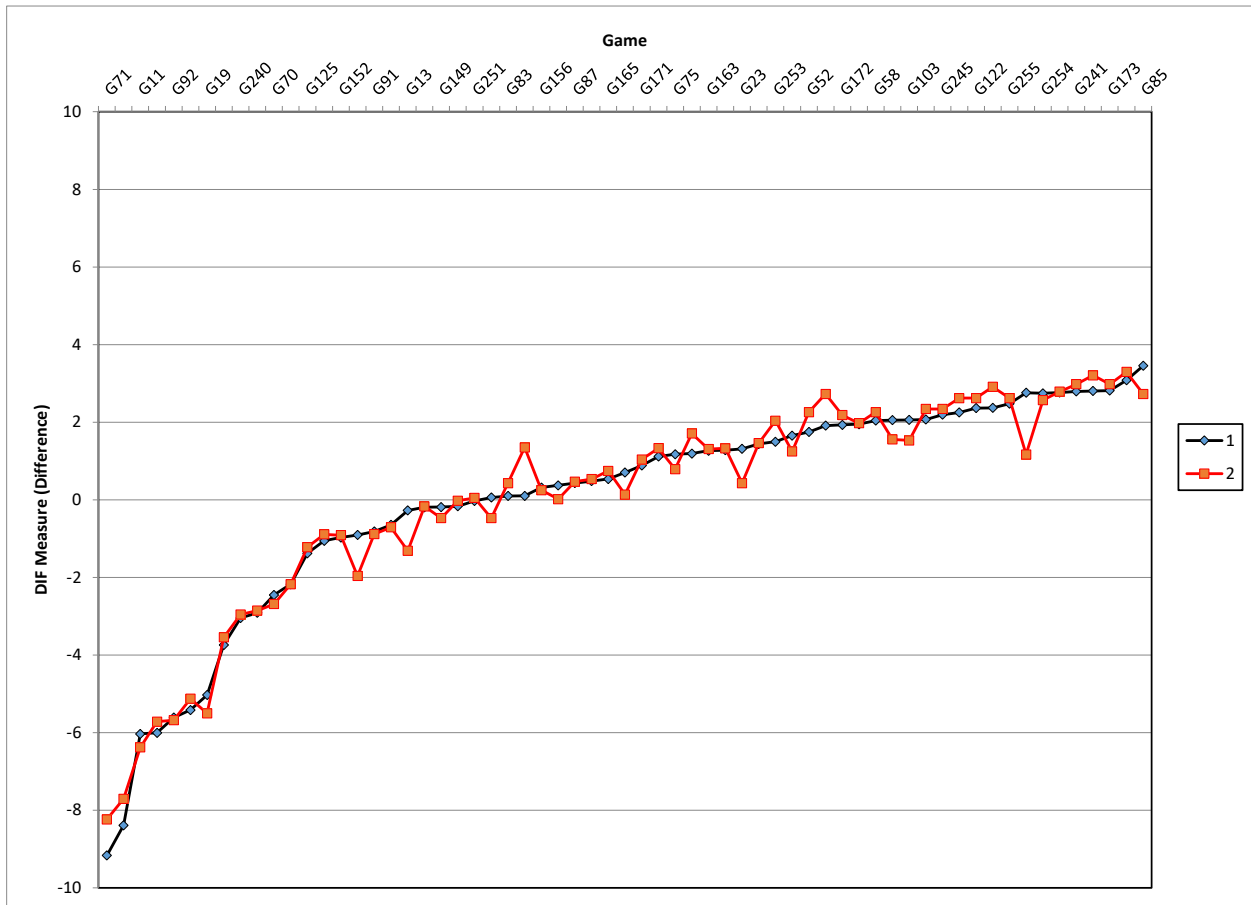


Figure 14

Passing Rates: Literacy (1 = English, 2 = Spanish)

