

Formative Evaluation of the Ignite Experiences for Young Children from Hatch Early Learning

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Similar to the previous report in 2020, this study was designed as a formative evaluation. It provides some beginning validation evidence to support the instructional use of the Ignite experiences and may offer evidence-based identification of experiences that can be investigated for revision and enhancement. Since the previous report, a wide range of improvements has been made to the experiences and the analyses and reporting in this report are designed to explore the impact of the experience revisions.

Description of the Sample

The analyses outlined in this report were conducted using the entire population of 3 and 4-year-old children who used Ignite during the 2020-2021 academic year ($n = 29,417$). For each domain-specific analysis, all 3 and 4-year-old children who attempted at least one experience within a given domain were retained. This process resulted in the following domain-specific sample sizes: Social Studies ($n = 29,386$), Science ($n = 25,339$), Social and Emotional Development ($n = 22,709$), Language ($n = 25,122$), Physical Development ($n = 24,703$), Mathematics ($n = 24,531$), and Literacy ($n = 23,757$). This strategy differs somewhat from the analytical strategy used for the 2020 technical report. The focus of that report was experience-specific analyses, and children were retained only if they attempted the focal experience. For this report, domain-specific analyses were the focus, and therefore if a child attempted any experience within a particular domain, the experiences they did not attempt were considered not passed given that the child did not progress through the experiences far enough to attempt the more advanced experiences. In a few cases, no children in the sample attempted a particular experience, and therefore that experience was removed from its respective domain-specific analysis.

The sample was split almost evenly between male (49.5%) and female (50.5%) children. Three-year-olds composed 36.8% of the sample and four-year-olds composed 63.2% of the sample. The racial / ethnic composition of the sample was as follows: white (non-Hispanic) – 43.9%, black (non-Hispanic) –

25.7%, Asian – 1.4%, Native American – 3.0%, Hispanic – 26.0%. Geographically, the sample comprised children from across the entire customer base, and therefore was national in scope.

Method

In the previous report that followed the 2019-2020 academic year, several findings emerged that called for further study with data that are more recent. Specifically, evidence that supports the argument that children with more developed skill sets can outperform children with lower-level skill sets is a basic type of validity evidence for any type of developmental assessment or progressive skills-based training. However, the 2019-2020 data revealed that four-year-olds did not outperform three-year-olds for many of the experiences. Evidence that the experiences become more difficult to pass as they rise in skill level is an important part of the validity argument for the instructional usefulness of any instructional strategy designed to help children build progressively more challenging and advanced skills. However, the 2019-2020 results revealed there were many experiences with an apparent mismatch between their nominal skill level and the rate at which children passed the experiences. In this report, we focus on evaluating improvements in these two areas.

To address the potential problem of mismatch between intended and data-driven experience difficulty levels, we adopted several specific analytical definitions and methods. Four criteria were used to evaluate the match. First, we examined the initial passing rates for each experience, which is the percent of children passing on first attempt. This method was adopted for the purposes of evaluating experience difficulty independent of practice effects. Next, we examined whether the passing rates tended to decrease in a way that corresponded with increases in nominal experience skill level. Specifically, this means that Beginning skill level experiences should be passed at a higher rate than Emerging experiences, which in turn should be passed at a higher rate than Intermediate experiences, followed by Accomplishing and finally by experiences with Proficient skill levels.

Next, the Rasch measurement model was used as an exploratory strategy to estimate difficulty. This approach estimates difficulty relative to all other experiences within the same domain in terms of logit units. Experiences with model-estimated difficulty of .5 logits or higher, meaning an experience location of at least .5 logits above the average experience difficulty within the respective domain, were considered “Difficult.” Experiences with model-estimated difficulty of -.5 logits or lower, meaning an experience location of at least .5 logits below the average experience difficulty within the respective domain, were considered “Easy.” Experiences with locations on the ability scale within .5 logits of the average difficulty level for the respective domain were considered “Average.” We then compared these empirical experience difficulty levels to the nominal or intended skill level for each experience. Experiences were labeled a mismatch if they had a nominal skill level of Beginning or Emerging and a model-estimated difficulty level of Difficult, or conversely, a nominal skill level of Accomplishing or Proficient and a model-estimated difficulty level of Easy. Finally, we examined the developmental pathway generated by the Rasch model. Each of the tables in this report are arranged so the experiences are listed in descending order of model-estimated difficulty. As one reads from the bottom of each table to the top, the results progress from the easiest experiences to most difficult experiences. This pathway evaluates whether the rank order of experience difficulty generally followed the expected hierarchy of skill level for each domain.

Results

Domain 1 – Social Studies

During the 2019-2020 academic year, there was very little difference between 3-year-olds and 4-year-olds in terms of their initial passing rates for the experiences in the Social Studies domain. The results of the analyses from the 2020-2021 academic year indicate a large improvement in the experience specific differences between 3-year-olds and 4-year olds in terms of initial passing rates within the Science domain. Specifically, the results from the 2020-2021 academic year indicate that four-year-old children had higher initial passing

rates than three-year-old children for every experience. The advantage in initial passing rates for four-year-old children ranged from as little as 3.6 percentage points for Experience 198 to as much as 21.1 percentage points for Experience 69. We will examine these same comparisons by age group for each of the seven domains of development addressed by Ignite experiences in order to demonstrate a type of validity evidence to support the use of the experiences with young children. If the experiences are sensitive to the developmental status of young children, then 4-year-old children should be able to pass the experiences at a higher rate than 3-year-old children.

As discussed earlier in this report, the Rasch measurement model assumes that the separate items, in this case experiences, are all measuring the same underlying latent construct or skill. This assumption is called unidimensionality. For the Social Studies domain, this assumption could not be maintained. Rather, the experiences clustered into two separate measures, each of which could support unidimensionality. For the purpose of this report, we will refer to the first cluster of experiences as “Who I Am” and the second as “Where I Live.” The “Who I Am” experiences cluster includes all the experiences that involve a child in drawing their family, home, and self. The “Where I Live” experience cluster includes all of the experiences that involve a child in drawing their neighborhood and community. There were several unexpected findings related to this experience structure. First, Experience 1, I Can Draw Myself, did not fit together with either cluster of experiences even though Experience 148, I Can Draw Myself Continued Practice fit with the “Who I Am” experience cluster. Second, Experience 22, I Can Draw My Home, fit with the “Where I Live” experience cluster, even though Experience 168, I Can Draw My Home Continued Practice, fit with the “Who I Am” experience cluster. This may be related to the topics and content children focus on when they first draw these topics as compared to the topics and content they address upon further practice and elaboration. A closer review of the content of these experiences may be needed to fully understand these results. It is important to note the for the remaining six domains

of development it was not necessary to divide the experiences into separate clusters in order to apply the Rasch model for the purpose of estimating the difficulty of the experiences. For each of the other domains, to a greater or lesser extent, the experiences fit together sufficiently to maintain the assumption that they were measuring the same underlying overall skill dimension.

For the 2019-2020 academic year, there were large differences between intended and empirical experience difficulty levels for many of the Social Studies experiences. For the 2020-2021 academic year, there were fewer mismatches between intended and empirical experience difficulty levels. The measurement model classified four of the six Social Studies experiences with nominal skill levels of Beginning or Emerging as Easy and classified the remaining two Beginning or Emerging skill level experiences as Difficult. The first mismatch was Experience 202, which had a nominal skill level of Beginning, a model-estimated difficulty level that reached the threshold for Difficult, and an initial passing rate of only 6.6%. The second mismatch was Experience 168, which had a nominal skill level of Emerging, a model-estimated difficulty level of Difficult, and an initial pass rate 12.4%. Overall, the Beginning and Emerging experiences had initial pass rates that ranged from 6.6% to 68.6%.

The Social Studies domain analyses included three experiences with Intermediate nominal skill levels. One of these experiences was classified as Easy and two were classified as Difficult. The Intermediate experiences had initial passing rates that ranged from 11.6% to 45.6%. The Social Studies domain analyses included six experiences with nominal skill levels of Accomplishing or Proficient. The measurement model classified five of these six experiences as Difficult. However, there was one mismatch between nominal and model-estimated difficulty levels. Experience 135 had a nominal skill level of Proficient, a model-estimated difficulty level of Easy, and an initial pass rate of 15.8%. Overall, these higher skill levels experiences within the Social Studies domain had initial pass rates that ranged from 4.0% (Experience 198) to 20.8% (Experience 97).

These results, when taken together, demonstrate a clear progression of increasing experience difficulty from the Beginning skill level to the Proficient skill level for the “Where I Live” experiences. This pattern emerged as measured by both percent passing their first attempt and model-estimated difficulty levels with one exception, Experience 202 discussed above. The results in Table 1 illustrate a well-defined developmental pathway of skills acquisition through which children can progress as they engage with the experiences in the Social Studies domain. The results showed a full range of experience difficulty levels ranging from as low as -9.29 logits to as high as 6.96 logits. The easiest experience was I Can Draw My Home, which had a nominal skill level of Emerging, a model-estimated difficulty level of Easy (-9.29 logits), and an initial pass rate of 68.6%. Similarly, the next easiest experience, I Can Draw My Neighborhood, had a nominal skill level of Beginning, a model-estimated difficulty level of Easy (-5.96 logits), and an initial pass rate of 55.8%. The most difficult experience, Identifying Community Helpers, had a nominal skill level of Proficient, a model-estimated difficulty level of Difficult (6.96 logits), and an initial pass rate of only 4.0%. However, it is important to note that the set of experiences that help children learn about where they live had a large number of Difficult experiences compared to the number of Easy experiences, and did not include any experiences of average difficulty level.

The pattern of results for the “Who I Am” experiences was less clear. The most difficult experience was I Can Draw About Myself Continued Practice, which had a nominal skill level of Proficient, a model-estimated difficulty level of Difficult (7.93 logits), and an initial pass rate of 9.4%. However, the rank order of the experiences, from easiest to most difficult, was as follows: Intermediate, Proficient, Beginning, Emerging, Intermediate, Accomplishing, and Proficient. Two of these experiences, 168 and 135, represent mismatched between nominal skill level and model-estimated difficulty level, and the overall pattern is disordered.

Domain 4 - Science

For the 2019-2020 academic year, 4-year-olds did not outperform 3-year-olds for many of the experiences in the Science domain. Overall, the results of the analyses from the 2020-2021 academic year indicate a large improvement in the experience specific differences between 3-year-olds and 4-year olds in terms of initial passing rates within the Science domain. Specifically, the results from the 2020-2021 academic year indicate that four-year-old children had higher initial pass rates than three-year-olds for every experience. The advantage in initial passing rates for four-year-old children ranged from as little as 2.2 percentage points for Experience 161 to as much as 16.1 percentage points for Experience 53.

For the 2019-2020 academic year, there were also large differences in intended and empirical experience difficulty levels for many of the experiences. For the 2020-2021 academic year, there were no mismatches between intended and empirical experience difficulty levels. This pattern is evident in several important ways. First, the measurement model did not classify any experiences with a nominal skill level of Beginning or Emerging as Difficult. Similarly, the measurement model did not classify any experiences with a nominal skill level of Proficient or Accomplishing as Easy. Furthermore, the initial pass rates became systematically lower as the nominal skill level of the experiences progressed from Beginning to Proficient.

Specifically, the Science domain analyses included four Beginning level experiences and all four had a model-estimated difficulty level of Easy. The initial pass rates for the Beginning experiences ranged from 33.5% (Experience 25) to 56.8% (Experience 48). The Science domain analyses included four Emerging level experiences. Two of these experiences were classified as Easy and two were classified as Average. The initial pass rates for the Emerging experiences ranged from 26.3% (Experience 72) to 41.8% (Experience 29). The Science domain analyses included four Intermediate level experiences. Two of these experiences were classified as Easy and two were classified as Average. The initial pass rates for the Intermediate experiences ranged from 20.9% (Experience 112) to 34.3%

(Experience 53). The Science domain analyses included four Accomplishing level experiences. One of these experiences was classified as Average and three were classified as Difficult. The initial pass rates for the Accomplishing experiences ranged from 7.5% (Experience 187) to 26.4% (Experience 93). The Science domain analyses included four Proficient level experiences. One of these experiences was classified as Average and three were classified as Difficult. The initial pass rate for all Proficient experiences was less than 19%.

These results, when taken together, demonstrate a clear progression of increasing experience difficulty from the Beginning skill level to the Proficient skill level. This pattern emerged as measured by both percent passing their first attempt and model-estimated difficulty levels. The results in Table 2 also illustrate a well-defined developmental pathway of skills acquisition through which children can progress as they engage with the experiences in the Science domain. The Science experiences were relatively equally represented across the Easy, Average, and Difficult model-estimated difficulty levels. The results showed a full range of experience difficulty levels ranging from as low as -2.59 logits to as high as 3.29 logits. The easiest experience was the Nature Scavenger Hunt, which had a nominal skill level of Beginning, a model-estimated difficulty level of Easy (-2.59 logits), and an initial pass rate of 56.8%. Similarly, the next easiest experience, Which is a Living Thing, had a nominal skill level of Beginning, a model-estimated difficulty level of Easy (-2.17 logits), and an initial pass rate of 51.3%. The most difficult experience was Recycling and Reusing, had a nominal skill level of Proficient, a model-estimated difficulty level of Difficult (3.29 logits), and an initial pass rate of 2.8%. Similarly, the next most difficult experience, Uses of Scientific Tools, had a nominal skill level of Proficient, a model-estimated difficulty level of Difficult (2.59 logits), and an initial pass rate of 4.7%.

Domain 9 – Social and Emotional Development

The results for Domain 9 mirror those for Domain 4. For the 2019-2020 academic year, 4-year-olds did not outperform 3-year-olds for many of the experiences in the Social-Emotional domain. Overall, the results of the analyses from the 2020-2021 academic year indicate a large improvement in the experience-specific differences between 3-year-olds and 4-year olds in terms of initial passing rates within the Social and Emotional domain. Specifically, the results from the 2020-2021 academic year indicate that four-year-old children had higher initial pass rates than three-year-olds for every experience. The advantage in initial passing rates for four-year-old children ranged from as little as 8.8 percentage points for Experience 118 to as much as 18.7 percentage points for Experience 9.

For the 2019-2020 academic year, there were also large differences in intended and empirical experience difficulty levels for many of the experiences. For the 2020-2021 academic year, there were no mismatches between intended and empirical experience difficulty levels. Again, this pattern is evident in several important ways. First, the measurement model did not classify any experiences with a nominal skill level of Beginning or Emerging as Difficult. Similarly, the measurement model did not classify any experiences with a nominal skill level of Proficient or Accomplishing as Easy. Furthermore, the initial pass rates became systematically lower as the nominal skill level of the experiences progressed from Beginning to Proficient.

Specifically, the Social and Emotional domain analyses included two Beginning level experiences and both of them had a model-estimated difficulty level of Easy. The initial pass rates for the Beginning experiences ranged from 34.5% (Experience 66) to 65.1% (Experience 3). The Social-Emotional domain analyses included one Emerging level experience and it was classified as Easy with an initial pass rate of 45.7% (Experience 9). The Social-Emotional domain analyses included two Intermediate level experiences and both of them were classified as Average. The initial pass rates for the Intermediate experiences ranged from 21.0% (Experience 76) to 22.7% (Experience 99).

The Social-Emotional domain analyses included two Accomplishing level experiences and both of them were classified as Difficult. The initial pass rates for the Accomplishing experiences ranged from 9.9% (Experience 118) to 16.8% (Experience 123). The Social-Emotional domain analyses included three Proficient level experiences and all three of them were classified as Difficult. The initial pass rates for all Proficient experiences was less than 17%.

Similar to the results for Domain 4, these results demonstrate a clear progression of increasing experience difficulty from the Beginning skill level to the Proficient skill level. This pattern emerged as measured by both percent passing their first attempt and model-estimated difficulty levels. The results in Table 3 also illustrate a well-defined developmental pathway of skills acquisition through which children can progress as they engage with the experiences in the Social-Emotional domain. The Social-Emotional experiences were relatively equally represented across the Easy, Average, and Difficult model-estimated difficulty levels. The results showed a full range of experience difficulty levels ranging from as low as -3.50 logits to as high as 1.82 logits. The easiest experience was Happy or Sad, which had a nominal skill level of Beginning, a model-estimated difficulty level of Easy (-3.50 logits), and an initial pass rate of 65.1%. Similarly, the next easiest experience, Tired or Mad, had a nominal skill level of Emerging, a model-estimated difficulty level of Easy (-1.99 logits), and an initial pass rate of 45.7%. The most difficult experience was Solving Social Problems 2, with a nominal skill level of Proficient, a model-estimated difficulty level of Difficult (1.82 logits), and an initial pass rate of 9.9%. Similarly, the next most difficult experience, Supporting the Emotions of Others, had a nominal skill level of Accomplishing, a model-estimated difficulty level of Difficult (1.82 logits), and an initial pass rate of 9.9%.

Domain 12 – Language and Communication

The results for Domain 12 were generally very positive with some exceptions. For the 2019-2020 academic year, 4-year-olds did not outperform 3-year-olds for many of the experiences in the Language domain. Overall, the

results of the analyses from the 2020-2021 academic year indicate a large improvement in the experience specific differences between 3-year-olds and 4-year olds in terms of initial passing rates within the Language domain. Specifically, the results from the 2020-2021 academic year indicate that four-year-old children had higher initial pass rates than three-year-olds for almost every experience. For three experiences (44, 83 and 87), no children passed their initial attempt and therefore there were no differences between 3-year-old children and 4-year-old children. For Experience 4, a very large percentage of both 3-year-olds (95.0%) and 4-year-olds (93.8%) passed the experience on their initial attempt. For the remaining 34 experiences, there was the expected advantage in initial passing rates for four-year-old children, which ranged from as little as 0.7 percentage points for Experience 85 to as much as 14.5 percentage points for Experience 50.

For the 2019-2020 academic year, there were some differences in intended and empirical experience difficulty levels for a few of the Language experiences. For the 2020-2021 academic year, there were matches between intended and empirical experience difficulty levels for 32 of the 38 experiences. However, the measurement model identified six mismatches. The statistical model classified one Beginning experience as Difficult (Experience 44), three Emerging experiences as Difficult (28, 75, and 156), and two Accomplishing experiences as Easy (64 and 78). However, the overall pattern was positive in that the initial pass rates generally became systematically lower as the nominal skill level of the experiences progressed from Beginning to Proficient.

Specifically, the Language domain analyses included seven Beginning level experiences. Six of them had a model-estimated difficulty level of Easy and one of them had a model-estimated difficulty level of Difficult. The initial pass rates for the Beginning experiences ranged from 0.0% (Experience 44) to 94.2% (Experience 4). The Language domain analyses included eight Emerging level experiences. Five of them were classified as Easy and three were classified as Difficult. The initial pass rates for the Emerging experiences ranged from 5.4% (Experience 156) to 80.1% (Experience 16). The Language domain analyses

included seven Intermediate level experiences. Two of them were classified as Difficult and five were classified as Easy. The initial pass rates for the Intermediate experiences ranged from 1.5% (Experience 85) to 33.1% (Experience 41). The Language domain analyses included nine Accomplishing level experiences. The model classified two of them as Easy, one as Average, and six as Difficult. The initial pass rates for the Accomplishing experiences ranged from 0.0% (Experience 87) to 23.4% (Experience 64). The Language domain analyses included seven Proficient level experiences and three of them were classified as Average and four as Difficult. The initial pass rates for all Proficient experiences was less than 16%.

These results demonstrate a relatively clear progression of increasing experience difficulty from the Beginning skill level to the Proficient skill level. This pattern emerged as measured by both percent passing their first attempt and model-estimated difficulty levels. The results in Table 4 also illustrate a plausible developmental pathway of skills acquisition through which children can progress as they engage with the experiences in the Language domain. The Language experiences were relatively equally represented across the Easy, Average, and Difficult model-estimated difficulty levels, although there were fewer experiences of Average difficulty than expected. The results showed a full range of experience difficulty levels ranging from as low as -7.72 logits to as high as 8.46 logits. The easiest experience was Classroom Cleanup, which had a nominal skill level of Beginning, a model-estimated difficulty level of Easy (-7.72 logits), and an initial pass rate of 94.2%. Similarly, the next easiest experience, Moon Mission, had a nominal skill level of Emerging, a model-estimated difficulty level of Easy (-5.50 logits), and an initial pass rate of 80.1%. The most difficult experience was Use of Less Common Objects, with a nominal skill level of Accomplishing, a model-estimated difficulty level of Difficult (8.46 logits), and an initial pass rate of 0.0%. Similarly, the next most difficult experience, Use of Common Objects, had a nominal skill level of Accomplishing, a model-estimated difficulty level of Difficult (7.36 logits), and an initial pass rate of 0.0%.

Domain 19 – Physical Development

The results for Domain 19 are similar to those for Domains 4 and 9 with one noted exception. For the 2019-2020 academic year, 4-year-olds did not outperform 3-year-olds for many of the experiences in the Physical domain. Overall, the results of the analyses from the 2020-2021 academic year indicate a large improvement in the experience specific differences between 3-year-olds and 4-year olds in terms of initial passing rates within the Physical domain. Specifically, the results from the 2020-2021 academic year indicate that four-year-old children had higher initial pass rates than three-year-olds for every experience. The advantage in initial passing rates for four-year-old children ranged from as little as 2.0 percentage points for Experience 179 to as much as 18.2 percentage points for Experience 45.

For the 2019-2020 academic year, there were also large differences in intended and empirical experience difficulty levels for many of the Physical experiences. For the 2020-2021 academic year, there were no mismatches between intended and empirical experience difficulty levels for 15 of the 16 experiences. Again, this pattern is evident in several important ways. First, the measurement model classified just one of the six experiences with a nominal skill level of Beginning or Emerging as Difficult. Experience 32 had a nominal skill level of Emerging, a model-estimated difficulty level that reached the threshold for Difficult, and had an initial passing rate of only 9.4%. The remaining five experiences with a nominal skill level of Beginning or Emerging were classified as either Easy or Average. The measurement model did not classify any experiences with a nominal skill level of Proficient or Accomplishing as Easy. As seen with the results from Domains 4 and 9, the initial pass rates became systematically lower as the nominal skill level of the experiences progressed from Beginning to Proficient.

Specifically, the Physical domain analyses included three Beginning level experiences. One of them had a model-estimated difficulty level of Easy and two of them had a model-estimated difficulty level of Average. The initial pass rates for the Beginning experiences ranged from 22.4% (Experience 17) to 57.4%

(Experience 5). The Physical domain analyses included three Emerging level experiences. Two of them were classified as Easy with initial pass rates of 50.6% (Experience 10) and 30.0% (Experience 74). The Physical domain analyses included three Intermediate level experiences. Two of them were classified as Average and one was classified as Easy. The initial pass rates for the Intermediate experiences ranged from 14.8% (Experience 114) to 37.6% (Experience 68). The Physical domain analyses included three Accomplishing level experiences. Two of them were classified as Average and one was classified as Difficult. The initial pass rates for the Accomplishing experiences ranged from 11.3% (Experience 137) to 23.8% (Experience 84). The Physical domain analyses included four Proficient level experiences and all of them were classified as Difficult. The initial pass rates for all Proficient experiences was less than 11%.

Similar to the results for Domains 4 and 9, these results demonstrate a clear progression of increasing experience difficulty from the Beginning skill level to the Proficient skill level. This pattern emerged as measured by both percent passing their first attempt and model-estimated difficulty levels. The results in Table 5 also illustrate a well-defined developmental pathway of skills acquisition through which children can progress as they engage with the experiences in the Physical domain. The Physical experiences were relatively equally represented across the Easy, Average, and Difficult model-estimated difficulty levels. The results showed a full range of experience difficulty levels ranging from as low as -2.86 logits to as high as 2.75 logits. The easiest experience was Self-Care Experience Show, which had a nominal skill level of Beginning, a model-estimated difficulty level of Easy (-2.86 logits), and an initial pass rate of 57.4%. Similarly, the next easiest experience, Morning Routine, had a nominal skill level of Emerging, a model-estimated difficulty level of Easy (-2.38 logits), and an initial pass rate of 50.6%. The most difficult experience was Making a Healthy Meal, with a nominal skill level of Proficient, a model-estimated difficulty level of Difficult (2.75 logits), and an initial pass rate of only 3.2%. Similarly, the next most difficult experience, Self-Care Collage, had a nominal skill level of Proficient, a model-estimated difficulty level of Difficult (1.75 logits), and an initial pass rate of 6.7%.

Domain 23 – Mathematics

The results for Domain 23 were similar to the results for Domain 12 and were generally very positive, and with some exceptions. For the 2019-2020 academic year, 4-year-olds did not outperform 3-year-olds for many of the experiences in the Mathematics domain. Overall, the results of the analyses from the 2020-2021 academic year indicate a large improvement in the experience specific differences between 3-year-olds and 4-year olds in terms of initial passing rates within the Mathematics domain. Specifically, the results from the 2020-2021 academic year indicate that four-year-old children had higher initial pass rates than three-year-olds for every experience. The expected advantage in initial passing rates for four-year-old children ranged from as little as 1.5 percentage points for Experience 6 to as much as 19.3 percentage points for Experience 54.

For the 2019-2020 academic year, there were some differences in intended and empirical experience difficulty levels for a few of the Mathematics experiences. For the 2020-2021 academic year, there were matches between intended and empirical experience difficulty levels for 53 of the 57 experiences. However, the measurement model identified four mismatches. The statistical model classified three Emerging experiences as Difficult (100, 133, and 138), and one Accomplishing experience as Easy (47). However, the overall pattern was positive in that the initial pass rates generally became systematically lower as the nominal skill level of the experiences progressed from Beginning to Proficient.

Specifically, the Mathematics domain analyses included 11 Beginning level experiences. Eight of them had a model-estimated difficulty level of Easy and three had a model-estimated difficulty level of Average. The initial pass rates for the Beginning experiences ranged from 13.9% (Experience 107) to 87.6% (Experience 6). The Mathematics domain analyses included 12 Emerging level experiences. Three of them were classified as Easy, six as Average, and three as Difficult. The initial pass rates for the Emerging experiences ranged from 9.9% (Experience 138) to 87.2% (Experience 12). The Mathematics domain analyses included 11 Intermediate level experiences. Eight of them were classified as Difficult, one as Average, and two as Easy. The initial pass rates

for the Intermediate experiences ranged from 2.0% (Experience 183) to 85.9% (Experience 15). The Mathematics domain analyses included 11 Accomplishing level experiences. The model classified one of them as Easy, two as Average, and eight as Difficult. The initial pass rates for the Accomplishing experiences ranged from 3.4% (Experience 186) to 29.4% (Experience 47). The Mathematics domain analyses included 12 Proficient level experiences and all of them were classified as Difficult. The initial pass rates for all Proficient experiences was less than 11%.

These results demonstrate a relatively clear progression of increasing experience difficulty from the Beginning skill level to the Proficient skill level. This pattern emerged as measured by both percent passing their first attempt and model-estimated difficulty levels. The results in Table 6 also illustrate a plausible developmental pathway of skills acquisition through which children can progress as they engage with the experiences in the Mathematics domain. The Mathematics experiences were relatively equally represented across the Easy, Average, and Difficult model-estimated difficulty levels, although there were more experiences of high difficulty than expected. The results showed a full range of experience difficulty levels ranging from as low as -6.93 logits to as high as 3.48 logits. The easiest experience was Bubble Counting, which had a nominal skill level of Beginning, a model-estimated difficulty level of Easy (-6.93 logits), and an initial pass rate of 87.6%. Similarly, the next easiest experience, Garden Counting, had a nominal skill level of Emerging, a model-estimated difficulty level of Easy (-6.86 logits), and an initial pass rate of 87.2%. While the most Difficult experience, Pattern Machine, had a nominal skill level of Intermediate, nine of the top 10 most difficult Mathematics experiences had nominal skill levels of Accomplishing or Proficient. For example, the next most difficult experience, Bead Bracelet Patterns, had a nominal skill level of Proficient, a model-estimated difficulty level of Difficult (2.78 logits), and an initial pass rate of only 3.4%.

Domain 35 – Literacy

The results for Domain 35 were similar to the results for Domains 12 and 23, and were generally very positive with some exceptions. For the 2019-2020 academic year, 4-year-olds did not outperform 3-year-olds for many of the experiences in the Mathematics domain. Overall, the results of the analyses from the 2020-2021 academic year indicate a large improvement in the experience specific differences between 3-year-olds and 4-year olds in terms of initial passing rates within the Mathematics domain. Specifically, the results from the 2020-2021 academic year indicate that four-year-old children had higher initial pass rates than three-year-olds for every experience except one. For Experience 11, the overall passing rate was very high (93.4%). The initial passing rate for 3-year-olds was 94.5% and 92.8% for 4-year-olds. The expected advantage in initial passing rates for four-year-old children for the rest of the experiences in the Literacy domain ranged from as little as 1.4 percentage points for Experience 23 to as much as 14.9 percentage points for Experience 71.

For the 2019-2020 academic year, there were some differences in intended and empirical experience difficulty levels for a few of the Literacy experiences. For the 2020-2021 academic year, there were matches between intended and empirical experience difficulty levels for 38 of the 41 experiences. However, the measurement model identified three mismatches. The statistical model classified two Emerging experiences as Difficult (23 and 189), and one Proficient experience as Easy (27). However, the overall pattern was very positive in that the initial pass rates generally became systematically lower as the nominal skill level of the experiences progressed from Beginning to Proficient.

Specifically, the Literacy domain analyses included six Beginning level experiences and all of them had a model-estimated difficulty level of Easy. The initial pass rates for the Beginning experiences ranged from 19.6% (Experience 13) to 93.4% (Experience 11). The Literacy domain analyses included six Emerging level experiences. One of them were classified as Easy, three as Average, and two as Difficult. The initial pass rates for the Emerging experiences ranged from 8.1% (Experience 189) to 22.3% (Experience 33). The Literacy

domain analyses included five Intermediate level experiences. One of them were classified as Difficult, three as Average, and one as Easy. The initial pass rates for the Intermediate experiences ranged from 9.9% (Experience 149) to 20.0% (Experience 46). The Literacy domain analyses included nine Accomplishing level experiences. The model classified five of them as Average and four as Difficult. The initial pass rates for the Accomplishing experiences ranged from 3.6% (Experience 109) to 17.2% (Experience 52). The Literacy domain analyses included 15 Proficient level experiences. Almost all of them, 12 of the 15, were classified as Difficult. Two Proficient experiences were classified as Average and one as Easy. The initial pass rates for all Proficient experiences was less than 20%.

These results demonstrate a clear progression of increasing experience difficulty from the Beginning skill level to the Proficient skill level. This pattern emerged as measured by both percent passing their first attempt and model-estimated difficulty levels. The results in Table 7 also illustrate a well-defined developmental pathway of skills acquisition through which children can progress as they engage with the experiences in the Literacy domain. The Literacy experiences were relatively equally represented across the Easy, Average, and Difficult model-estimated difficulty levels. The results showed a full range of experience difficulty levels ranging from as low as -8.32 logits to as high as 2.12 logits. The easiest experience was Rhyming, which had a nominal skill level of Beginning, a model-estimated difficulty level of Easy (-8.32 logits), and an initial pass rate of 93.4%. Similarly, the next easiest experience, Magic Hat 1, had a nominal skill level of Beginning, a model-estimated difficulty level of Easy (-6.75 logits), and an initial pass rate of 86.5%. The most difficult experience, Teddy Bear Rhyme, had a nominal skill level of Proficient, a model-estimated difficulty level of Difficult (2.12 logits), and an initial pass rate of only 3.5%. The next most difficult experience, Blending Word Parts, had a nominal skill level of Accomplishing, a model-estimated difficulty level of Difficult (2.08 logits), and an initial pass rate of only 3.6%.

Summary

This report outlines new validity evidence for the instructional usefulness of the Ignite experiences. The main focal points were the performance differences between 3 and 4-year-olds, and the match or mismatch between intended experience skill levels and empirically generated experience difficulty levels. With respect to the age differences in performance, 4-year-old children outperformed 3-year-old children for 187 of the 192 experiences evaluated. The performance advantage for 4-year-olds was often substantial. The difference was usually greater than 10 percentage points, often greater than 15 percentage points, and reached as high as 21.1 percentage points. Only five experiences presented exceptions to this finding. For three of them, the passing rates were 0.0%, meaning that three-year-old did not outperform 4-year-old children. Rather, the experiences were simply so difficult that no children passed on their first attempt. For the other two experiences, three-year-old children outperformed 4-year-old children by less than 2 percentage points, and both of these experiences had passing rates greater than 93.0%. These experiences were easy enough that nearly all children, regardless of age pass on their first attempt. Therefore, with respect to age differences, the results support a very strong and greatly improved validity argument.

Of the 192 experiences evaluated within the domain-specific analyses, the results suggested a possible mismatch between intended skill level and experience difficulty for only 17 (8.8%) of the experiences. There were no potential mismatches identified for the Science and Social-Emotional domains. For the remaining domains, the Physical domain had only one potential mismatch, Social Studies and Literacy had three each, and Language and Mathematics each had four potential mismatches. Each of these potential mismatches can be investigated further with an eye toward experience enhancements.

Overall, the findings of this study highlight substantial improvements to the experiences. Child age was related to initial passing rates as expected. A plausible developmental pathway emerged for each domain that ranged from

the easiest experiences to most difficulty experiences, and the pathway generally corresponded very well to the intended nominal skill levels. Many fewer experiences presented potential mismatches between skill level and difficulty level. Future research can reach beyond initial passing rates to examine whether overall passing after repeated attempts and further practice impact the findings.

Table 1.
Difficulty levels for Games within Domain 1 - Social Studies.

	Game ID	Percent Passing			Skill Level	Difficulty Level	Game Difficulty	Game Name	
		3s	4s	Overall					
	1	19.5	25.4	23.3	Beginning	1	----	I Can Draw Myself	
Who I Am	193	6.3	11.3	9.4	Proficient	5	Difficult	7.93	I Can Draw About Myself Continued Practice
	177	7.6	13.4	11.3	Accomplishing	4	Difficult	3.75	I Can Draw My Interests Continued Practice
	175	7.9	13.7	11.6	Intermediate	3	Difficult	2.97	I Can Draw My Family Continued Practice
	168	8.4	14.7	12.4	Emerging	2	Difficult	1.20	I Can Draw My Home Continued Practice
	148	11.0	18.1	15.5	Beginning	1	Easy	-2.53	I Can Draw Myself Continued Practice
	135	10.4	18.9	15.8	Proficient	5	Easy	-2.76	I Can Draw About Myself
	60	36.8	49.3	45.6	Intermediate	3	Easy	-10.55	I Can Draw My Family
Where I Live	198	1.7	5.3	4.0	Proficient	5	Difficult	6.96	Identifying Community Helpers
	202	4.2	7.9	6.6	Beginning	1	Difficult	5.17	I Can Draw My Neighborhood Continued Practice
	178	6.6	15.6	12.3	Accomplishing	4	Difficult	3.31	Building a Neighborhood 2
	108	13.0	25.4	20.8	Intermediate	3	Difficult	1.35	Uses of Neighborhood Features
	97	14.3	24.7	20.8	Accomplishing	4	Difficult	1.34	I Can Draw My Interests
	69	32.1	53.2	41.4	Emerging	2	Easy	-2.88	Building a Neighborhood
	40	48.6	60.0	55.8	Beginning	1	Easy	-5.96	I Can Draw My Neighborhood
22	64.1	71.2	68.6	Emerging	2	Easy	-9.29	I Can Draw My Home	

Note. $n = 29,386$. **Bolded and italicized** games may represent mismatch between intended and empirical difficulty.

Table 2.
Difficulty levels for Games within Domain 4 - Science.

	Game ID	Percent Passing			Skill Level	Difficulty Level	Game Difficulty	Game Name	
		3s	4s	Overall					
Science	161	1.4	3.6	2.8	Proficient	5	Difficult	3.29	Recycling and Reusing
	195	2.3	6.1	4.7	Proficient	5	Difficult	2.59	Uses of Scientific Tools
	187	3.9	9.4	7.5	Accomplishing	4	Difficult	1.95	Which Tools to Use?
	81	5.2	10.3	8.5	Accomplishing	4	Difficult	1.76	How Living Things Change
	127	7.0	16.8	13.3	Proficient	5	Difficult	1.04	Living Things Game Show
	154	8.2	18.7	15.0	Accomplishing	4	Difficult	0.83	Weather Windows
	134	10.3	23.5	18.8	Proficient	5	Average	0.42	Magnet Fun
	112	12.1	25.8	20.9	Intermediate	3	Average	0.21	Sorting Scientific Tools
	95	14.9	28.3	23.6	Intermediate	3	Average	-0.04	Weather Game Show
	72	16.8	31.6	26.3	Emerging	2	Average	-0.27	Everyday Tools
	93	16.5	31.9	26.4	Accomplishing	4	Average	-0.28	Sorting Living Things
	62	19.4	33.2	28.3	Emerging	2	Average	-0.44	Environmental Changes
	42	21.3	35.9	30.7	Intermediate	3	Easy	-0.63	Basic Needs
	43	23.8	36.4	31.9	Emerging	2	Easy	-0.73	Senses and Texture
	25	25.8	37.8	33.5	Beginning	1	Easy	-0.85	Object Properties
	53	23.9	40.0	34.3	Intermediate	3	Easy	-0.91	What Our Senses Do
	29	32.2	47.2	41.8	Emerging	2	Easy	-1.47	Which is a Living Thing 2
	37	36.6	50.3	45.0	Beginning	1	Easy	-1.71	Simple Scientific Tools
	2	43.2	55.8	51.3	Beginning	1	Easy	-2.17	Which is a Living Thing
	48	48.3	61.4	56.8	Beginning	1	Easy	-2.59	Nature Scavenger Hunt

Note. *n* = 25,339.

Table 3.
Difficulty levels for Games within Domain 9 - Social-Emotional.

	Game ID	Percent Passing			Skill Level	Difficulty Level	Game Difficulty	Game Name	
		3s	4s	Overall					
Social-Emotional	201	3.9	13.2	9.9	Proficient	5	Difficult	1.82	Solving Social Problems 2
	118	4.2	13.0	9.9	Accomplishing	4	Difficult	1.82	Supporting the Emotions of Others
	170	5.4	15.9	12.3	Proficient	4	Difficult	1.39	Solving Social Problems
	123	8.3	21.3	16.8	Accomplishing	3	Difficult	0.71	Who Can Help?
	139	8.3	21.4	16.8	Proficient	5	Difficult	0.70	Guess Which Friend
	76	13.6	24.9	21.0	Intermediate	3	Average	0.19	Understanding Emotions
	99	13.1	27.9	22.7	Intermediate	5	Average	-0.01	Reacting to Social Problems
	66	24.1	40.0	34.5	Beginning	1	Easy	-1.12	Recognizing Social Problems
	9	33.5	52.2	45.7	Emerging	2	Easy	-1.99	Tired or Mad
	3	57.7	69.1	65.1	Beginning	1	Easy	-3.50	Happy or Sad

Note. *n* = 22,709.

Table 4.
 Difficulty levels for Games within Domain 12 - Language and Communication.

	Game ID	Percent Passing			Skill Level	Difficulty Level	Game Difficulty	Game Name	
		3s	4s	Overall					
Language & Comm.	87	0.0	0.0	0.0	Accomplishing	3	Difficult	8.46	Use of Less Common Objects
	83	0.0	0.0	0.0	Accomplishing	2	Difficult	7.36	Use of Common Objects
	44	0.0	0.0	0.0	Beginning	1	Difficult	6.91	Common Objects Game Show
	85	1.1	1.8	1.5	Intermediate	3	Difficult	3.00	How to Read a Book
	173	1.8	6.5	4.9	Proficient	5	Difficult	1.55	I Spy Features of Print
	122	2.1	6.5	5.0	Accomplishing	4	Difficult	1.52	Identifying Book Features
	156	2.3	7.1	5.4	Emerging	2	Difficult	1.41	Following Print Continued Practice
	111	3.0	7.1	5.7	Proficient	5	Difficult	1.35	Building a Spaceship
	75	3.3	7.9	6.3	Emerging	2	Difficult	1.20	Following Print
	103	3.0	8.5	6.5	Intermediate	3	Difficult	1.15	How to Read a Book Continued Practice
	192	3.0	8.7	6.7	Proficient	5	Difficult	1.11	Building a Spaceship Continued Practice
	181	3.1	10.5	7.9	Accomplishing	4	Difficult	0.88	Words in Categories 2 Continued Practice
	159	3.7	11.1	8.5	Proficient	5	Difficult	0.77	Another Day at the Museum
	67	4.8	10.9	8.7	Accomplishing	4	Difficult	0.72	Words in Categories 2
	28	7.0	10.5	9.2	Emerging	2	Difficult	0.63	Common Signs
	203	6.6	11.6	9.9	Accomplishing	4	Difficult	0.53	Name Writing 2 Continued Practice
	197	7.0	12.1	10.3	Proficient	5	Average	0.47	Write What You See Continued Practice
	185	8.1	13.7	11.7	Proficient	5	Average	0.26	Write What You See!
	130	7.5	19.3	15.1	Proficient	5	Average	-0.17	A Day at the Museum
	142	10.7	18.6	15.8	Accomplishing	4	Average	-0.25	Name Writing 2
	125	12.9	21.7	18.6	Intermediate	3	Easy	-0.55	Name Writing
	116	14.1	23.8	20.4	Emerging	2	Easy	-0.72	I Can Draw My Birthday Party
	78	13.2	26.6	21.8	Accomplishing	4	Easy	-0.86	Functional Words
	64	15.1	27.9	23.4	Accomplishing	4	Easy	-1.00	Underwater Instructions
	35	19.0	27.1	24.2	Intermediate	3	Easy	-1.08	2-Step Directions
	70	16.9	30.7	25.8	Beginning	1	Easy	-1.21	Print Versus Pictures
	92	18.6	29.8	25.8	Beginning	1	Easy	-1.21	Making Scribbles
	55	19.5	29.7	26.1	Intermediate	3	Easy	-1.23	2-Step Directions Continued Practice
	36	21.1	34.1	29.5	Emerging	2	Easy	-1.51	Common Signs Continued Practice
	50	22.5	37.0	31.9	Intermediate	3	Easy	-1.69	Words in Categories Continued Practice
	41	24.3	38.0	33.1	Intermediate	3	Easy	-1.79	Words in Categories
	30	29.5	42.4	37.8	Emerging	2	Easy	-2.14	Word Blocks Continued Practice
	24	29.9	43.3	38.5	Emerging	2	Easy	-2.19	Word Blocks
	7	34.5	48.0	43.2	Beginning	1	Easy	-2.52	Basic Words
	21	37.1	50.4	45.7	Beginning	1	Easy	-2.70	Basic Words Continued Practice
14	45.0	58.3	53.6	Beginning	1	Easy	-3.26	Color Words	
16	77.1	81.7	80.1	Emerging	2	Easy	-5.50	Moon Mission	
4	95.0	93.8	94.2	Beginning	1	Easy	-7.72	Classroom Cleanup	

Note. $n = 25,122$. **Bolded and italicised** games may represent mismatch between intended and empirical difficulty.

Table 5.
Difficulty levels for Games within Domain 19 - Physical Development.

	Game ID	Percent Passing First Attempt			Skill Level	Difficulty Level	Game Difficulty	Game Name	
		3s	4s	Overall					
Physical Development	179	1.9	3.9	3.2	Proficient	5	Difficult	2.75	Making a Healthy Meal
	190	2.9	8.7	6.7	Proficient	5	Difficult	1.75	Self-Care Collage
	199	3.3	9.4	7.2	Proficient	5	Difficult	1.64	Self-Care Collage Continued Practice
	32	6.2	11.1	9.4	Emerging	2	Difficult	1.25	Healthy Gornit
	196	5.0	13.6	10.5	Proficient	5	Difficult	1.07	Stay and Play or Walk Away?
	137	6.3	14.0	11.3	Accomplishing	4	Difficult	0.96	Safe and Healthy Behaviors 2
	114	8.2	18.5	14.8	Intermediate	3	Average	0.50	Safe and Healthy Behavior
	105	10.0	20.8	17.0	Intermediate	3	Average	0.25	Healthy Breakfast
	119	10.2	22.8	18.3	Accomplishing	4	Average	0.11	Healthy Menu
	45	32.1	50.3	43.9	Beginning	1	Average	-0.19	Personal Safety
	17	17.0	25.3	22.4	Beginning	1	Average	-0.28	Nutritious Meal
	84	15.9	28.1	23.8	Accomplishing	4	Average	-0.41	Washing Your Hands
	74	19.3	35.9	30.0	Emerging	2	Easy	-0.92	Playing Safely
	68	26.8	43.5	37.6	Intermediate	3	Easy	-1.49	Self-Care Shopping Trip
	10	40.5	56.1	50.6	Emerging	2	Easy	-2.38	Morning Routine
	5	52.9	59.9	57.4	Beginning	1	Easy	-2.86	Self-Care Game Show

Note. $n = 24,703$. **Bolded and italicized** games may represent mismatch between intended and empirical difficulty.

Table 6.
Difficulty levels for Games within Domain 23 - Mathematics.

	Game ID	Percent Passing			Skill Level	Difficulty Level	Game Difficulty	Game Name	
		3s	4s	Overall					
Mathematics	183	0.9	2.6	2.0	Intermediate	3	Difficult	3.48	Pattern Machine
	194	1.4	4.5	3.4	Proficient	5	Difficult	2.78	Bead Bracelet Patterns
	186	1.5	4.5	3.4	Accomplishing	4	Difficult	2.77	Pattern Machine 2
	164	1.7	5.3	4.0	Proficient	5	Difficult	2.55	Bubble Popping
	160	1.8	5.5	4.2	Accomplishing	4	Difficult	2.50	Zoo Subtraction
	143	2.1	5.8	4.5	Proficient	5	Difficult	2.39	Tidying Tob-E's Room
	158	1.9	6.5	4.9	Proficient	5	Difficult	2.26	Adding Birds
	131	2.2	6.6	5.1	Accomplishing	4	Difficult	2.22	Zoo Addition
	184	2.3	7.3	5.5	Accomplishing	4	Difficult	2.09	Which Does Not Belong?
	174	2.7	7.3	5.7	Proficient	5	Difficult	2.04	3-Dimensional Shape Spinner
	182	3.1	7.9	6.2	Proficient	5	Difficult	1.91	Nonstandard Measurement
	150	2.8	8.4	6.4	Intermediate	3	Difficult	1.86	Subtraction Fiesta
	77	4.2	8.9	7.3	Proficient	5	Difficult	1.65	Numeral Roller Coaster
	96	3.6	9.8	7.6	Intermediate	3	Difficult	1.58	Adding Maracas
	124	4.2	9.8	7.8	Proficient	5	Difficult	1.53	Fish Feeding
	162	3.9	10.3	8.0	Accomplishing	4	Difficult	1.50	Ice Cream Truck Shape Puzzle
	141	4.2	10.3	8.2	Proficient	5	Difficult	1.46	Fish Feeding Continued Practice
	153	4.2	10.4	8.2	Intermediate	3	Difficult	1.46	Shape Asteroids
	191	4.3	10.3	8.2	Proficient	5	Difficult	1.46	Monster Collection
	129	4.6	12.3	9.6	Accomplishing	4	Difficult	1.18	First, Second, & Last
	167	5.2	12.1	9.7	Intermediate	3	Difficult	1.17	Packing Presents
	138	5.2	12.4	9.9	Emerging	2	Difficult	1.13	Sky Patterning
	157	5.5	12.6	10.1	Proficient	5	Difficult	1.10	Lining Up For Snack Time
	79	5.8	12.7	10.3	Intermediate	3	Difficult	1.06	Jungle Feeding
	169	6.2	12.7	10.4	Intermediate	3	Difficult	1.03	Camping Trip
	100	4.8	13.7	10.5	Emerging	2	Difficult	1.02	Alien Subtraction
	176	6.2	13.0	10.6	Accomplishing	4	Difficult	1.01	Helping Gormit
	86	6.6	13.3	10.9	Proficient	5	Difficult	0.95	Counting to Compare Sets
	110	6.2	14.6	11.6	Intermediate	3	Difficult	0.83	Identifying First and Second
	133	7.7	16.2	13.2	Emerging	2	Difficult	0.58	Measuring Dinosaurs
	126	7.5	17.0	13.7	Accomplishing	4	Difficult	0.52	Frame of Reference Instructions
	107	9.0	16.5	13.9	Beginning	1	Average	0.49	Matching Socks
	113	8.7	18.2	14.9	Intermediate	3	Average	0.35	Proximity Instructions
	98	9.8	17.9	15.1	Emerging	2	Average	0.32	Moving Day Directions
	117	9.2	18.8	15.4	Emerging	2	Average	0.27	Which Ones Belong?
	90	8.5	19.8	15.8	Beginning	1	Average	0.21	Separating Objects
	61	10.5	19.0	16.0	Accomplishing	4	Average	0.19	Pairing Sets
	101	9.0	19.8	16.0	Emerging	2	Average	0.19	Matching Simple Shapes 2
	120	10.2	20.6	16.9	Beginning	1	Average	0.07	Caterpillar Patterns
	63	9.4	23.2	18.4	Emerging	2	Average	-0.11	Adding Groups 2
	145	11.5	24.5	19.9	Emerging	2	Average	-0.29	Garden Counting Continued Practice
	38	13.2	23.8	20.0	Emerging	2	Average	-0.31	Last In Line
	94	12.2	25.7	20.9	Accomplishing	4	Average	-0.41	How Many Peas?
	104	14.1	26.8	22.3	Beginning	1	Easy	-0.56	Measuring Volume & Length
	51	18.7	33.3	28.1	Intermediate	3	Easy	-1.15	Which Has More Aliens?
	47	20.4	34.3	29.4	Accomplishing	4	Easy	-1.26	What Comes Before or After
	54	20.2	39.5	32.7	Beginning	1	Easy	-1.56	Adding Groups
	65	29.6	43.0	38.3	Beginning	1	Easy	-2.03	Matching Simple Shapes
	56	29.4	43.4	38.4	Beginning	1	Easy	-2.05	Direction Words
	26	32.7	50.2	44.0	Beginning	1	Easy	-2.50	First In Line
	34	61.1	69.6	66.6	Emerging	2	Easy	-4.35	Burger Slider 2
	31	63.7	71.8	69.0	Emerging	2	Easy	-4.57	Mushroom Counting
	20	76.5	80.6	79.2	Beginning	1	Easy	-5.68	Burger Slider 1
	18	78.4	82.0	80.7	Beginning	1	Easy	-5.88	Set Counting
	15	84.8	86.5	85.9	Intermediate	3	Easy	-6.64	Counting Backward
	12	86.2	87.7	87.2	Emerging	2	Easy	-6.86	Garden Counting
	6	86.6	88.1	87.6	Beginning	1	Easy	-6.93	Bubble Counting

Note. $n = 24,531$. **Bolded and italicised** games may represent mismatch between intended and empirical difficulty.

Table 7.
Difficulty levels for Games within Domain 35 - Literacy.

	Game ID	Percent Passing			Skill Level	Difficulty Level	Game Difficulty	Game Name	
		3s	4s	Overall					
Literacy	172	1.4	4.7	3.5	Proficient	5	Difficult	2.12	Teddy Bear Rhyme
	109	1.7	4.7	3.6	Accomplishing	4	Difficult	2.08	Blending Word Parts
	146	1.6	5.1	3.9	Proficient	5	Difficult	1.99	Blending Word Parts 2
	163	2.9	8.3	6.4	Accomplishing	4	Difficult	1.29	Which Word Does Not Rhyme?
	155	3.7	9.1	7.2	Proficient	5	Difficult	1.11	Letter Rockets Continued Practice
	180	3.4	9.2	7.2	Proficient	5	Difficult	1.11	Story Comprehension 5
	151	3.5	9.4	7.3	Proficient	5	Difficult	1.08	Letter Clouds Continued Practice
	80	4.6	9.1	7.5	Accomplishing	4	Difficult	1.04	Lowercase Letter Jellies 2
	147	3.9	10.0	7.9	Proficient	5	Difficult	0.97	Asteroid Letters Continued Practice
	189	4.2	10.2	8.1	Emerging	2	Difficult	0.93	Story Comprehension 2 Continued Practice
	88	4.7	10.0	8.1	Proficient	4	Difficult	0.92	Lowercase Space Letters
	144	4.1	10.3	8.1	Proficient	5	Difficult	0.92	Letter Leaves Continued Practice
	140	4.5	10.9	8.7	Proficient	5	Difficult	0.82	Letter Rockets
	73	4.8	10.9	8.7	Accomplishing	4	Difficult	0.81	Onsets and Rimes
	136	4.6	10.9	8.7	Proficient	5	Difficult	0.81	Letter Clouds
	132	4.8	11.8	9.4	Proficient	5	Difficult	0.69	Asteroid Letters
	128	5.0	12.3	9.7	Proficient	5	Difficult	0.63	Letter Leaves
	23	8.9	10.3	9.8	Emerging	2	Difficult	0.61	Magic Hat 2
	149	4.7	12.7	9.9	Intermediate	3	Difficult	0.59	Rhyming Race
	82	6.8	12.7	10.6	Emerging	2	Average	0.48	Putting Words Together
	165	5.9	13.7	11.0	Accomplishing	4	Average	0.43	Story Comprehension 4
	121	5.6	14.1	11.1	Proficient	5	Average	0.41	Beginning Sounds
	102	6.1	15.2	12.0	Accomplishing	4	Average	0.27	Sound Suitcases
	106	6.0	15.3	12.1	Intermediate	3	Average	0.26	Blending Compound Words
	115	6.1	15.8	12.4	Proficient	5	Average	0.21	Segmenting Words
	152	6.5	15.6	12.4	Intermediate	3	Average	0.21	Story Comprehension 3
	49	8.7	14.6	12.5	Accomplishing	2	Average	0.19	Uppercase Space Letters 2
	171	8.0	18.5	14.8	Accomplishing	4	Average	-0.12	Story Comprehension 4 Continued Practice
	39	12.1	18.7	16.4	Intermediate	3	Average	-0.3	Initial Sound Cards
	89	10.0	20.8	17.0	Emerging	2	Average	-0.38	Story Comprehension 2
	52	11.8	20.1	17.2	Accomplishing	3	Average	-0.4	Lowercase Letter Jellies
	91	9.9	21.7	17.6	Emerging	2	Average	-0.45	Matching Sounds
	13	13.6	22.8	19.6	Beginning	1	Easy	-0.67	Deleting Words
	27	13.5	23.1	19.7	Proficient	1	Easy	-0.69	Letter Jellies
	46	13.7	23.4	20.0	Intermediate	2	Easy	-0.71	Uppercase Space Letters 1
	59	12.1	24.3	20.0	Beginning	1	Easy	-0.72	Sounds in Sequence
	8	18.0	24.7	22.3	Beginning	1	Easy	-0.95	Segmenting Sentences
	33	15.7	25.9	22.3	Emerging	2	Easy	-0.95	Deleting Words 2
	71	19.4	34.3	29.1	Beginning	1	Easy	-1.57	Story Comprehension
	19	85.6	87.1	86.5	Beginning	1	Easy	-6.75	Magic Hat 1
	11	94.5	92.8	93.4	Beginning	1	Easy	-8.32	Rhyming

Note. *n* = 23,757. **Bolded and italicised** games may represent mismatch between intended and empirical difficulty.