Overview: By conducting observational assessment using the Galileo® Pre-K Online Educational Management System, early childhood providers are provided with measures of child learning and growth along with specific information about which capabilities the child has learned and which capabilities the child is ready to learn. Early childhood providers can use this information to track child progress along a developmental path and to guide the planning of developmentally appropriate learning opportunities. Different assessment tools can yield different information about child learning, depending on their specific characteristics. For example, authentic observational assessment in a naturalistic context may reveal evidence of child learning that is not revealed by direct assessment. For this reason, it is useful for early childhood providers to have information about the typical learning and growth of children as measured by a specific assessment tool. Although child learning and growth displays a great deal of normal variability, information about typical learning and growth can serve as one source of information that helps providers evaluate whether children are progressing appropriately over time. As part of the current study, ATI conducted research on a large sample of children assessed using Galileo to investigate typical growth and learning for children of various ages in various developmental domains. This information is being incorporated into the new Galileo *Child Learning and Growth Report* that will communicate information about the learning and growth of children relative to research-based estimates of typical learning and growth.

Design and Sample: The current study evaluated child learning and growth throughout the 2013-14 program year. The data in this study were collected as part of the ongoing multi-method observational assessments conducted by early childhood programs using the Galileo G3 scales for children ages birth to 8 months, 8 to 18 months, 18 to 24 months, 2 to 3 years, and 3 through 5 years. For the scales for children birth to 3 years, child learning and growth was evaluated for five assessment scales in each age range targeting various developmental domains (i.e., *Approaches to Learning*; *Cognitive Development and General Knowledge*; *Language, Communication, Reading, and Writing*; *Physical Development and Health*; and *Social and Emotional Development*) as well as a *School Readiness Scale* for each age range consisting of a variety of critical school readiness capabilities drawn from the assessment scales. Observations were conducted in 37 early childhood programs in 15 states nationwide. On average, six observations were conducted for each child for each scale throughout the 2013-14 program year. The sample for each scale contained, on average, 6,388 observations representing 1,091 children. For the scales for children 3 through 5 years, child learning and growth was evaluated for 12 assessment scales targeting various developmental domains (i.e., *Approaches to Learning*, *Creative Arts*, *Early Math*, *English Language Acquisition*, *Language*, *Literacy*, *Logic and Reasoning*, *Nature and Science*, *Physical Development and Health*, *Social and Emotional Development*, *Social Studies, Technology*) as well as a *School Readiness Scale* consisting of 88 critical school readiness capabilities drawn from the assessment scales. Observations were conducted in 97 early childhood programs in 27 states nationwide. On average, six observations were conducted for each child for each scale throughout the 2013-14 program year. The sample for each scale contained, on average, 226,987 observations representing 35,020 children.

Measures of Child Learning and Growth: ATI uses procedures based in Item Response Theory to estimate a difficulty and discrimination parameter for each capability within each Galileo scale on a regular basis. Based on these analyses and the observational assessment data for a child for a given scale, Galileo provides an estimate of child learning (i.e., the Developmental Level [DL] score) for that age

Research Brief
Typical Learning and Growth in Multiple Developmental Domains for Children
Ages Birth through 5 Based on 2013-14 Assessment Data
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range and developmental domain. Since DL scores within an age range and domain are on a common scale, child growth can be measured via the change in DL score over time.

Effect of Child Age on Learning: For the current study, a linear regression analysis was conducted for each scale to evaluate the relationship between child DL score and child age (in months). Each analysis resulted in a regression equation that best describes, for a given scale, the change in DL scores as child age increases. The estimate of the slope from the regression equation can be interpreted as the increase in the DL score associated with a one month increase in child age. The regression equation can also be used to generate an estimate of typical learning (i.e., DL score) for any given age within the age range of the scale. Table 1 presents, for each scale, an estimate of the typical increase in learning (i.e., change in DL score) for each one month increase in child age. For each scale, estimates of typical learning (i.e., DL scores) are also provided for children of various ages. As would be expected, DL scores increased as child age increased. Overall, from birth to 5 years children typically increased their DL score by more than 300 points, or approximately 60 points each year (i.e., 1.2 standard deviations). Within the scales for each age range, the increase in the DL score associated with a one month increase in child age was generally similar across developmental domains.

TABLE 1

Estimates of typical learning (DL scores) for children of various ages assessed using Galileo® G3 scales for various age ranges and developmental domains

Estimates of Typical Learning for Children of Various Ages				
Galileo G3 Assessment Scale	**Typical Monthly Increase**	**Typical DL Score for Minimum Age for Scale**	**Typical DL Score for Midpoint Age for Scale**	**Typical DL Score for Maximum Age for Scale**
00-08 months: G3 Approaches to Learning	12.81	198 (for 0 months)	249 (for 4 months)	301 (for 8 months)
00-08 months: G3 Cognitive Development and General Knowledge	10.15	216 (for 0 months)	257 (for 4 months)	298 (for 8 months)
00-08 months: G3 Language, Communication, Reading, & Writing	10.85	213 (for 0 months)	257 (for 4 months)	300 (for 8 months)
00-08 months: G3 Physical Development and Health	11.54	236 (for 0 months)	282 (for 4 months)	328 (for 8 months)
00-08 months: G3 Social and Emotional Development	10.02	220 (for 0 months)	260 (for 4 months)	300 (for 8 months)
00-08 months: Galileo School Readiness	11.00	230 (for 0 months)	274 (for 4 months)	318 (for 8 months)

TABLE 1 – Continued

Estimates of typical learning (DL scores) for children of various ages assessed using Galileo® G3 scales for various age ranges and developmental domains

Estimates of Typical Learning for Children of Various Ages

Galileo G3 Assessment Scale	Typical Monthly Increase	Typical DL Score for Minimum Age for Scale	Typical DL Score for Midpoint Age for Scale	Typical DL Score for Maximum Age for Scale
08-18 months: G3 Approaches to Learning	6.61	296 (for 8 months)	329 (for 13 months)	363 (for 18 months)
08-18 months: G3 Cognitive Development and General Knowledge	7.16	285 (for 8 months)	321 (for 13 months)	357 (for 18 months)
08-18 months: G3 Language, Communication, Reading & Writing	7.68	280 (for 8 months)	318 (for 13 months)	357 (for 18 months)
08-18 months: G3 Physical Development and Health	6.66	301 (for 8 months)	334 (for 13 months)	368 (for 18 months)
08-18 months: G3 Social and Emotional Development	6.15	298 (for 8 months)	329 (for 13 months)	359 (for 18 months)
08-18 months: Galileo School Readiness	5.96	320 (for 8 months)	350 (for 13 months)	380 (for 18 months)
18-24 months: G3 Approaches to Learning	6.26	394 (for 18 months)	412 (for 21 months)	431 (for 24 months)
18-24 months: G3 Cognitive Development and General Knowledge	6.60	394 (for 18 months)	414 (for 21 months)	434 (for 24 months)
18-24 months: G3 Language, Communication, Reading and Writing	7.10	371 (for 18 months)	392 (for 21 months)	413 (for 24 months)
18-24 months: G3 Physical Development and Health	7.65	354 (for 18 months)	377 (for 21 months)	400 (for 24 months)
18-24 months: G3 Social and Emotional Development	4.28	370 (for 18 months)	383 (for 21 months)	396 (for 24 months)
18-24 months: Galileo School Readiness	7.05	369 (for 18 months)	390 (for 21 months)	411 (for 24 months)

TABLE 1 – Continued

Estimates of typical learning (DL scores) for children of various ages assessed   using Galileo® G3 scales for various age ranges and developmental domains

Estimates of Typical Learning for Children of Various Ages				
Galileo G3 Assessment Scale	**Typical Monthly Increase**	**Typical DL Score for Minimum Age for Scale**	**Typical DL Score for Midpoint Age for Scale**	**Typical DL Score for Maximum Age for Scale**
2-3 years: G3 Approaches to Learning	4.04	431 (for 24 months)	455 (for 30 months)	479 (for 36 months)
2-3 years: G3 Cognitive Development and General Knowledge	3.77	421 (for 24 months)	444 (for 30 months)	466 (for 36 months)
2-3 years: G3 Language, Communication, Reading & Writing	4.19	421 (for 24 months)	446 (for 30 months)	471 (for 36 months)
2-3 years: G3 Physical Development and Health	3.99	412 (for 24 months)	436 (for 30 months)	460 (for 36 months)
2-3 years: G3 Social and Emotional Development	3.17	422 (for 24 months)	441 (for 30 months)	460 (for 36 months)
2-3 years: Galileo School Readiness	4.39	428 (for 24 months)	455 (for 30 months)	481 (for 36 months)
3-5 years: Approaches to Learning	3.26	470 (for 36 months)	509 (for 48 months)	548 (for 60 months)
3-5 years: Creative Arts	4.13	490 (for 36 months)	539 (for 48 months)	589 (for 60 months)
3-5 years: Early Math	3.57	446 (for 36 months)	489 (for 48 months)	532 (for 60 months)
3-5 years: English Language Acquisition	2.41	470 (for 36 months)	499 (for 48 months)	527 (for 60 months)
3-5 years: Language	3.74	423 (for 36 months)	467 (for 48 months)	512 (for 60 months)
3-5 years: Literacy	3.83	433 (for 36 months)	479 (for 48 months)	525 (for 60 months)
3-5 years: Logic and Reasoning	3.21	503 (for 36 months)	542 (for 48 months)	580 (for 60 months)
3-5 years: Nature and Science	3.91	428 (for 36 months)	474 (for 48 months)	521 (for 60 months)
3-5 years: Physical Development	2.86	457	491	525

| | | | | & Health | (for 36 months) | (for 48 months) | (for 60 months) |

TABLE 1 – Continued

Estimates of typical learning (DL scores) for children of various ages assessed using Galileo® G3 scales for various age ranges and developmental domains

Estimates of Typical Learning for Children of Various Ages				
Galileo G3 Assessment Scale	Typical Monthly Increase	Typical DL Score for Minimum Age for Scale	Typical DL Score for Midpoint Age for Scale	Typical DL Score for Maximum Age for Scale
3-5 years: Social and Emotional Development	3.22	430 (for 36 months)	469 (for 48 months)	508 (for 60 months)
3-5 years: Social Studies	3.21	474 (for 36 months)	512 (for 48 months)	551 (for 60 months)
3-5 years: Technology	2.35	482 (for 36 months)	510 (for 48 months)	538 (for 60 months)
3-5 years: Galileo School Readiness	4.21	436 (for 36 months)	487 (for 48 months)	537 (for 60 months)

Effect of Learning Time on Growth: For the current study, a linear regression analysis was also conducted for each scale to evaluate the relationship between child DL score and time (in days). Time (in days) can be thought of as a proxy for time spent participating in developmentally appropriate learning opportunities, regardless of age. The analysis resulted in an equation that best describes the change in DL scores over time for a given scale. The estimate of the slope from the regression equation can be interpreted as the increase in the DL score associated with a one day increase in time (i.e., the daily typical growth rate). The daily typical growth rate can easily be translated into a typical growth value for a given time period by simply multiplying the daily typical growth rate by the number of days in the time period. Table 2 presents the daily typical growth rate for each scale in each age range along with estimates of the typical growth for a month (i.e., 30 days) and for the age range spanned by the scale. Regardless of child age, increased time spent participating in developmentally appropriate learning opportunities was associated with higher DL scores; however, the effect of learning time was more pronounced for children assessed on the scales for older age ranges than for children assessed on the scales for younger age ranges. Within the scales for each age range, the effect of learning time on growth was generally similar across developmental domains. The findings in the current study are generally consistent with the findings observed in previous ATI research investigating the effect of learning time on child growth throughout the 2012-13 program year.

TABLE 2

Daily growth rates and typical growth values in terms of change in DL scores for Galileo® G3 scales in various age ranges and developmental domains

Estimates of Typical Growth for Various Time Periods			
Galileo G3 Assessment Scale	**Daily Typical Growth Rate**	**Typical Growth for One Month (30 Days)**	**Typical Growth for Age Range Spanned by Scale (# of Days)**
00-08 months: G3 Approaches to Learning	0.04	1.28	10.28 (for 240 days)
00-08 months: G3 Cognitive Development and General Knowledge	0.04	1.20	9.60 (for 240 days)
00-08 months: G3 Language, Communication, Reading, & Writing	0.03	1.00	8.03 (for 240 days)
00-08 months: G3 Physical Development and Health	0.05	1.54	12.33 (for 240 days)
00-08 months: G3 Social and Emotional Development	0.04	1.34	10.69 (for 240 days)
00-08 months: Galileo School Readiness	0.05	1.38	11.03 (for 240 days)
08-18 months: G3 Approaches to Learning	0.09	2.65	26.52 (for 300 days)
08-18 months: G3 Cognitive Development and General Knowledge	0.11	3.26	32.62 (for 300 days)
08-18 months: G3 Language, Communication, Reading & Writing	0.12	3.50	35.02 (for 300 days)
08-18 months: G3 Physical Development and Health	0.09	2.83	28.33 (for 300 days)
08-18 months: G3 Social and Emotional Development	0.10	3.10	30.98 (for 300 days)
08-18 months: Galileo School Readiness	0.06	1.72	17.24 (for 300 days)

TABLE 2 – Continued

Daily growth rates and typical growth values in terms of change in DL scores for Galileo® G3 scales in various age ranges and developmental domains

Estimates of Typical Growth for Various Time Periods			
Galileo G3 Assessment Scale	**Daily Typical Growth Rate**	**Typical Growth for One Month (30 Days)**	**Typical Growth for Age Range Spanned by Scale (# of Days)**
18-24 months: G3 Approaches to Learning	0.06	1.81	10.86 (for 180 days)
18-24 months: G3 Cognitive Development and General Knowledge	0.04	1.23	7.38 (for 180 days)
18-24 months: G3 Language, Communication, Reading and Writing	0.03	1.05	6.30 (for 180 days)
18-24 months: G3 Physical Development and Health	0.01	0.16	0.96 (for 180 days)
18-24 months: G3 Social and Emotional Development	0.07	2.14	12.86 (for 180 days)
18-24 months: Galileo School Readiness	0.01	0.30	1.80 (for 180 days)
2-3 years: G3 Approaches to Learning	0.15	4.65	55.80 (for 360 days)
2-3 years: G3 Cognitive Development and General Knowledge	0.14	4.21	50.56 (for 360 days)
2-3 years: G3 Language, Communication, Reading & Writing	0.14	4.31	51.69 (for 360 days)
2-3 years: G3 Physical Development and Health	0.17	5.10	61.24 (for 360 days)
2-3 years: G3 Social and Emotional Development	0.13	3.82	45.82 (for 360 days)
2-3 years: Galileo School Readiness	0.09	2.67	32.01 (for 360 days)

TABLE 2 – Continued

Daily growth rates and typical growth values in terms of change in DL scores for ***Galileo***® *G3 scales in various age ranges and developmental domains*

Estimates of Typical Growth for Various Time Periods			
Galileo G3 Assessment Scale	**Daily Typical Growth Rate**	**Typical Growth for One Month (30 Days)**	**Typical Growth for Age Range Spanned by Scale (# of Days)**
3-5 years: Approaches to Learning	0.36	10.66	255.80 (for 720 days)
3-5 years: Creative Arts	0.44	13.13	315.21 (for 720 days)
3-5 years: Early Math	0.31	9.17	219.98 (for 720 days)
3-5 years: English Language Acquisition	0.26	7.65	183.69 (for 720 days)
3-5 years: Language	0.37	11.24	269.79 (for 720 days)
3-5 years: Literacy	0.33	9.95	238.90 (for 720 days)
3-5 years: Logic and Reasoning	0.32	9.53	228.73 (for 720 days)
3-5 years: Nature and Science	0.36	10.84	260.16 (for 720 days)
3-5 years: Physical Development & Health	0.29	8.57	205.64 (for 720 days)
3-5 years: Social and Emotional Development	0.32	9.62	230.89 (for 720 days)
3-5 years: Social Studies	0.31	9.22	221.21 (for 720 days)
3-5 years: Technology	0.37	11.07	265.69 (for 720 days)
3-5 years: Galileo School Readiness	0.34	10.19	244.62 (for 720 days)

Conclusion: The study described in this research brief evaluated the learning and growth displayed by a large nationwide sample of children assessed throughout the 2013-14 program year using the Galileo G3 scales for children ages birth to 8 months, 8 to 18 months, 18 to 24 months, 2 to 3 years, and 3 through 5 years. The regression analyses conducted as part of this study established estimates of typical learning for children of various ages as well as estimates of typical growth for various time periods for Galileo scales in a wide variety of developmental domains. The findings demonstrated a significant impact of both factors considered in this study (i.e., child age and learning time). These findings are consistent with the idea that both age-based developmental changes and time spent participating in developmentally appropriate learning opportunities play an important role in determining

typical learning and growth in early childhood. For this reason, early childhood providers need to have access not only to information about a child's learning and growth, but also to information about typical learning and growth for children of a similar age who have spent a similar period of time participating in developmentally appropriate learning opportunities. Along these lines, the new Galileo *Child Learning and Growth Report* will provide an individualized comparison of each child's learning and growth over a given time period to estimates of typical learning and growth for that time period. Early childhood providers can use this report as one source of information in evaluating whether children are progressing appropriately over time and whether children display learning that is typical for their age. Providers can then make adjustments to the curriculum and provide additional learning opportunities as needed to further promote child learning and growth.