

An Investigation of Growth Indices Obtained Using Value Tables

Introduction

Since its inception, the state accountability system has included separate measures that characterize student performance in schools and school districts in a specific year and student performance growth across two school years. Both the original Education Accountability Act of 1998 (EAA) and Act 282 of 2008, which amended the EAA, include an absolute performance rating and an improvement or growth rating. The original EAA required that schools and school districts receive two ratings: a rating for absolute performance and a rating for the improvement of performance. In 2008 the General Assembly amended “Improvement” performance to “growth”, and while the nomenclature changed, the calculation of student academic growth performance remained consistent. According to Section 59-18-120 (8), “growth means the rating a school will receive based on longitudinally matched student data comparing current performance to the previous year’s for the purpose of determining student academic growth.” The absolute and growth ratings on the annual state school and district report cards convey this information.

Absolute and growth measures provide complementary information regarding the outcomes of schooling: absolute measures provide information regarding current levels of student achievement, and growth measures provide information regarding the progress that students have made from one academic year to the next. Absolute measures reflect how well schools meet common criteria of academic achievement. Judging all students with respect to common achievement criteria is consistent with the view that all students, regardless of where they reside, need to acquire the same academic skills in order to obtain access to workplace or further educational opportunities. Absolute measures provide summary information about the achievement levels of students within a school or district with respect to these standards.

Growth measures provide summary information regarding the progress students make throughout an academic year. Regardless of their initial level of achievement, students have the opportunity to increase their level of achievement. Students may begin an academic year with widely disparate levels of achievement, yet schools should provide all students the opportunity to learn and grow academically. Presuming all students have the opportunity to grow by the same amount, summary measures of growth should not be related to summary measures of absolute status. As a result, absolute and growth measures provide different information about student achievement, and should operate as independently as possible.

Currently, the absolute and growth measures are communicated in two ways, ratings and indices. Report card ratings are communicated using five categories: Excellent, Good, Average, Below Average, and At Risk. Report card indices are numeric values that summarize student achievement and the gains in student achievement for each school and district. The report card indices are created first, and based on these indices report ratings are associated with each school or district. The process of deriving absolute and growth indices, and the association of these indices with absolute and growth ratings is defined by the Education Oversight Committee (EOC); the EOC publishes an Accountability Manual annually that describes in detail the data used and computations performed in establishing the ratings.

From 2002 through 2008 growth indices were obtained by taking the difference between the current year's absolute index and the previous year's absolute index. Beginning in 2009 growth indices were obtained using a value table method, in which individual students are awarded points based on their achievement level in the current and previous year. The value table methodology was suggested by an EOC National Advisory Committee. In a simple visual presentation, a value table presents the rewards that are awarded to students based on their academic performance at an initial point in time and their performance at a second point in time. Consider the following sample value table (Table 1). In this value table a student whose year 1 academic achievement was Met and year 2 academic achievement was Exemplary was awarded 120 points.

Table 1. Sample Value Table.

Year 1 Level	Year 2 Level		
	Not Met	Met	Exemplary
Exemplary	80	90	100
Met	80	100	120
Not Met	100	140	180

The construction of value tables is performed consistent with some judgment regarding the relative importance of different types of student gains. Questions that may be asked include:

1. Is the achievement of a specific achievement level the desired outcome?
2. What value is placed on students who maintain the same level of achievement? Is this value the same for all levels of achievement?
3. How are student gains at lower levels of achievement valued compared to student gains at higher levels of achievement?

The sample value table was created to address two of these questions: first, all students who maintain the same achievement level from year 1 to year 2 are rewarded equally (100 points), and second, gains made by lower achieving students are more valuable than those made by higher achieving students. For students initially scoring at the lowest level (Not Met) an additional 40 points is earned for each increase in achievement level in year 2, for students initially scoring at the middle level (Met) an additional 20 points is earned for each year 2 achievement level above Not Met, and for students initially scoring at the highest level (Exemplary) an additional 10 points is earned for each year 2 achievement level above Not Met.

Now consider the value table currently used to create the growth indices (Table 2). First, notice that the value table methodology uses five categories of student achievement on PASS rather than the three categories used to communicate student scores to parents; these categories are Not Met 1, Not Met 2, Met, Exemplary 4, and Exemplary 5. This table was created with the primary purpose of encouraging all students to reach the achievement level Met. Toward this end, the increment in awards for year two performance from Not Met 1 to Not Met 2 and from

Not Met 2 to Met is 20 points, while the increment in reward from Met to Exemplary 4 and from Exemplary 4 to Exemplary 5 is 10 points.

Table 2. Current Value Table

Year One (Pre-test)	Year Two (Post-test)				
	Not Met 1	Not Met 2	Met	Exemplary 4	Exemplary 5
Exemplary 5	40	60	80	90	100
Exemplary 4	50	70	90	100	110
Met	60	80	100	110	120
Not Met 2	70	90	110	120	130
Not Met 1	80	100	120	130	140

At the time this value table was created, two years of PASS data were not available to explore growth indices that could be created.

Analysis

The value tables used to compute the growth indices for the 2009, 2010, and 2011 elementary and middle report cards were adopted by the EOC in January of 2009. Use of the value table methodology as a means of computing growth ratings can be performed with many other value tables, with different outcomes. This investigation will:

1. consider the present and several alternative value tables, and describe the policy regarding student growth that each represents,
2. apply all value tables to data used to create growth indices for the 2010 and 2011 report cards,
3. examine the relationships among the absolute indices, growth indices, and poverty indices obtained, within and across academic years,
4. determine if these relationships are consistent for elementary and for middle schools, and
5. explain the correlations obtained using the value tables methodology.

Because measures of school and district achievement tend to be associated with the socio-economic status of the community the school serves, the relationships of both absolute and growth ratings to the socio-economic status of schools and districts will also be examined. The socio-economic status of schools and districts is quantified by the poverty index, which is the percentage of students participating in the federal free or reduced-price lunch program in the current year and/or eligible for Medicaid at any time in the past three years.

The relationships among these measures will be examined using correlation coefficients. A correlation coefficient is a measure of association between two variables. Values of a correlation coefficient can range from -1 to +1. When correlation coefficients are positive, higher values of the first variable are associated with higher values of the second variable, and lower values of the first variable are associated with lower values of the second variable. When correlation coefficients are negative, higher values of the first variable are associated with lower values of the second variable, and lower values of the first variable are associated with higher values of the second variable. The numeric value of a correlation coefficient becomes larger when each value of the first variable is associated with a more narrow range of values of the second variable.

How correlation coefficients vary can be seen using data from this study. Table 3 presents the correlations among absolute indices, growth indices, and poverty indices for elementary and middle school report card data from 2005 through 2010. For elementary schools in 2005 the correlation between absolute and growth indices was 0.28 (Figure 1), and for elementary schools in 2011 the correlation between absolute and growth indices was 0.76 (Figure 2). Notice that for the lower correlation coefficient (2005 report card year) the data do not appear to fall along a line, instead they seem to make a more circular shape, while the data with a higher correlation coefficient (2011 report card year) appear to fall along a line.

Table 3: Correlations among Absolute Indices, Growth Indices, and Poverty Indices for Elementary and Middle Schools for 2005 through 2011 Report Cards.

Growth Index Method & Report Card Year	Absolute Index with Growth Index		Absolute Index with Poverty Index		Growth Index with Poverty Index	
	Elementary	Middle	Elementary	Middle	Elementary	Middle
Difference Between Absolute Indices						
2005	.28	.40	-.78	-0.82	-0.12	-0.14
2006	.28	.27	-.77	-0.86	-0.11	-0.09
2007	.29	.36	-.80	-0.86	-0.16	-0.21
2008	.34	.26	-.80	-0.88	-0.20	-0.15
Value Table						
2009	.80	.86	-.83	-0.87	-0.60	-0.67
2010	.80	.90	-.82	-0.85	-0.55	-0.72
2011	.76	.91	-.80	-0.83	-0.50	-0.68

In Table 3 it can be seen that the relationship between absolute indices and growth indices has changed over time, as has the relationship between growth indices and poverty indices. For elementary schools the correlations between absolute and growth indices were approximately .30 from 2005 through 2008, and increased to approximately .80 for 2009 through 2011. The correlations between growth indices and the poverty index were approximately -.15 from 2005 through 2008, and increased to approximately -.60 from 2009 through 2011. These changes occurred when the process for creating growth indices changed to the use of the

growth value tables. Changes also occurred for middle schools at this time; correlations between absolute indices and growth indices changed from values near .35 (2005 through 2008) to values near .90 (2009 through 2011), and correlations between growth indices and poverty indices changed from values near -.15 (2005 through 2008) to values near -.70 (2009 through 2011).

Figure 1. Plot of Growth Indices by Absolute Indices for Elementary Schools from 2005 Report Cards (correlation = .28).

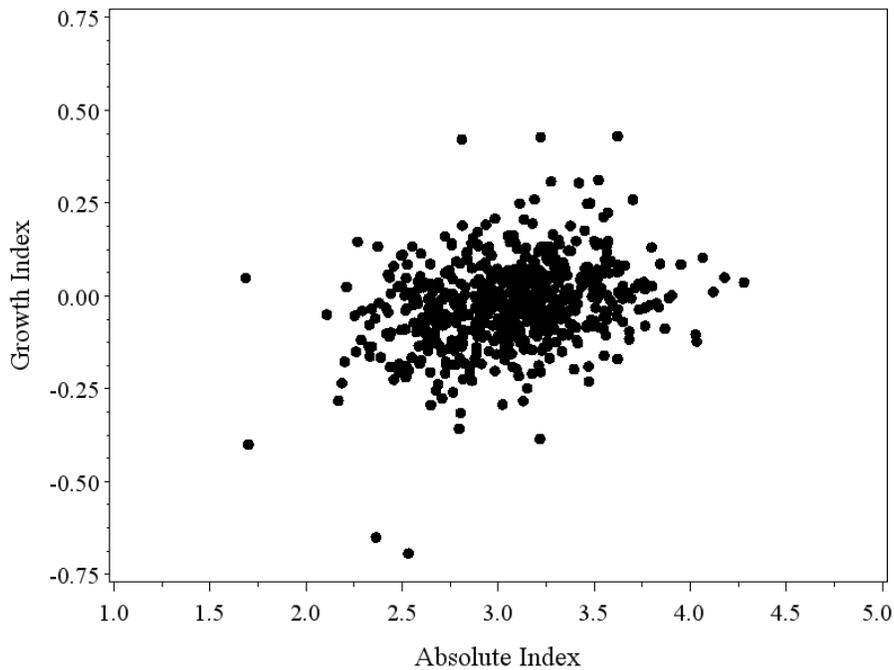


Figure 2. Plot of Growth Indices by Absolute Indices for Elementary Schools from 2011 Report Cards (correlation = .80).

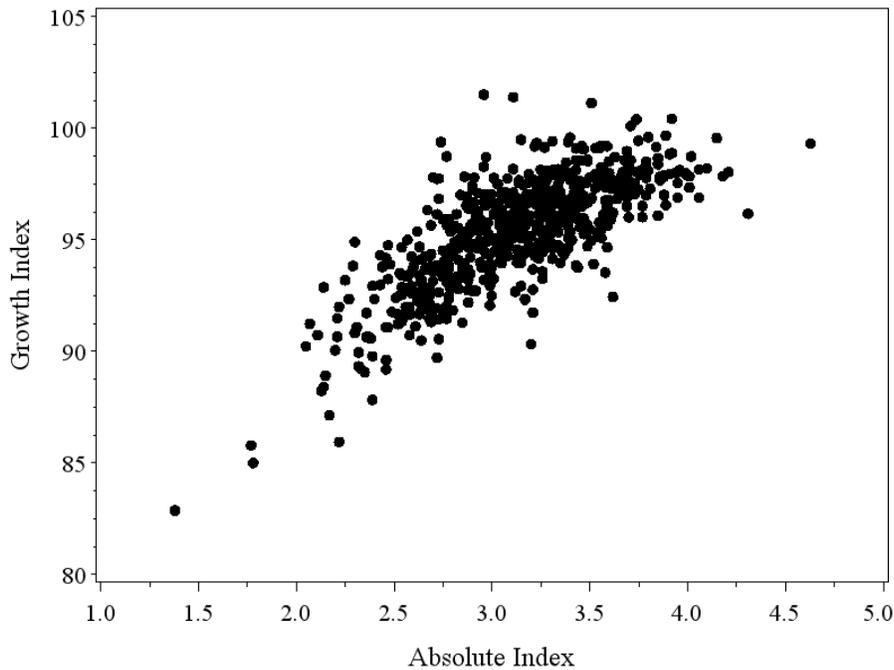


Figure 3 presents the association of absolute indices with poverty indices for 2011 elementary school report card data; the correlation between absolute indices and poverty indices is -0.80 . The correlation is negative because schools with higher levels of poverty tend to have lower absolute indices. Figure 4 presents the association between growth indices and poverty indices, again for 2011 elementary school report card data; the correlation between growth indices and poverty indices is -0.50 . This correlation is also negative because schools with higher levels of poverty tend to have lower growth indices. The correlation between growth ratings and poverty indices is smaller than the correlation between absolute indices and poverty indices. Visually, the difference can be seen in Figures 3 and 4, because among schools with the highest poverty indices, schools are much more variable in their growth indices than they are in their absolute indices.

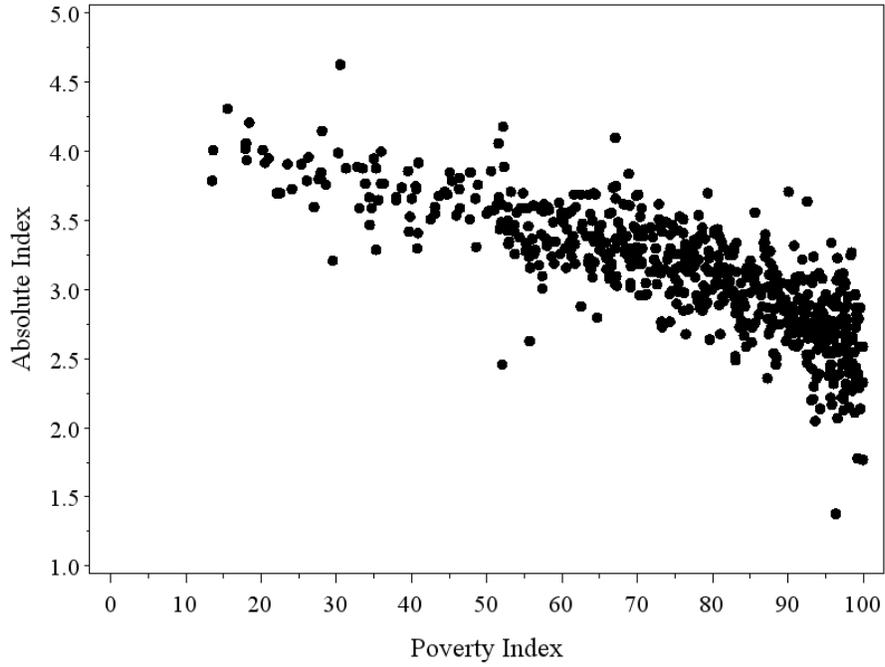


Figure 3. Scatterplot of Absolute Indices by Poverty Indices for Elementary Schools for the 2011 report cards.

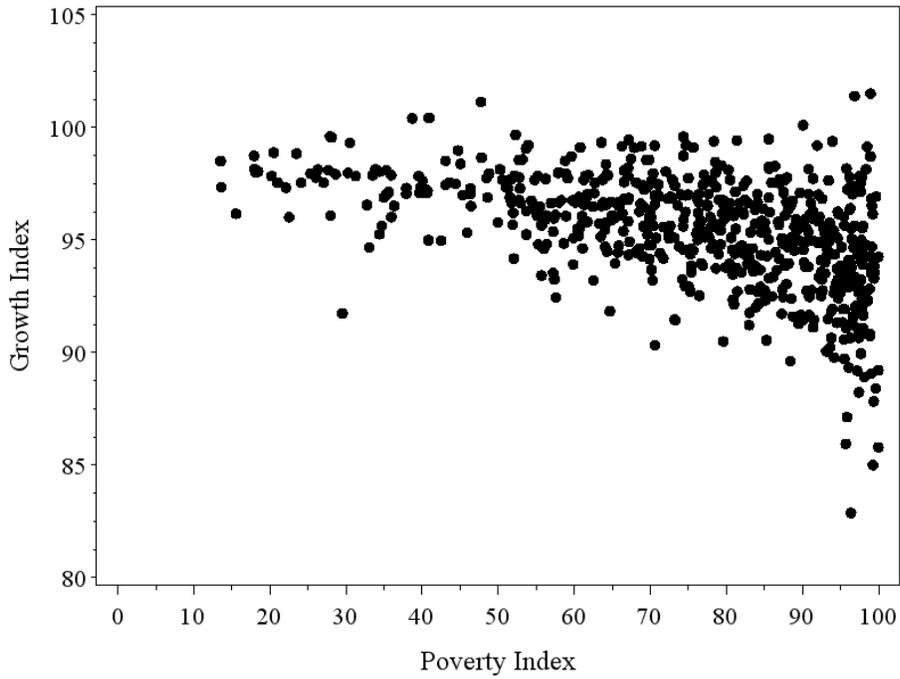


Figure 4. Scatterplot of Growth Indices by Poverty Indices for Elementary Schools for the 2011 report cards.

Methods

Data

The data used were obtained from the South Carolina Department of Education, and include Palmetto Assessment of State Standards (PASS) data for those students who were used to compute growth indices for the 2011 (obtained August 31, 2011) and 2010 (obtained October 12, 2010) report cards; these data were used to compute both absolute and growth indices. In practice, the data used to compute absolute indices differ from the data used to compute growth indices. For elementary schools, absolute indices are computed using PASS scores from all students enrolled in a school or district on the 45th-day of instruction and on the first day of testing. Growth indices are computed using a subset of these students; only those students for whom a PASS score can be found from the previous year (the previous year PASS score can be obtained while the student was enrolled in a different school). For middle schools, absolute indices are computed using students' PASS data, and data obtained from students who have been administered assessments as a part of the End-of-Course Examination Program (EOCEP). As with elementary schools, only those students enrolled in a school or district on the 45th-day of instruction and on the first day of testing are included. Growth indices for middle schools only utilize data from students for whom PASS scores can be found from the previous year. Students do not test in consecutive years with any EOCEP assessments, so EOCEP scores cannot be used as a part of growth indices.

This investigation will use only those students who can be used in the computation of growth indices; both absolute and growth indices will be computed using this one sample. Comparisons made between results of this study and the results of previous operational absolute and growth indices may be less valid for middle schools because the study sample may differ more from the operational sample for middle schools than for elementary schools. The relationships among indices obtained from the study sample and the operational sample will be examined. If the relationships among these indices are high, results obtained from the study sample may be used to infer results for an operational sample.

Computation of Absolute and Growth Indices

Absolute indices were computed consistent with the methodology described in the *2010-2011 Accountability Manual* in which a math index, an English/Language Arts (ELA) index, a science index, and a social studies index are computed, and a school/district absolute index is created by averaging these four indices. For elementary schools the weights of the four subject indices are .3, .3, .2, and .2, respectively; for middle schools each index has the same weight (.25). Growth indices were computed by assigning each student a value from a value table based on their score on each of two years of PASS. For each subject area a mean growth index is computed. The subject area growth indices are then combined using the same weights as were used to compute the absolute indices.

Value Tables

As a methodology to create summary information regarding student growth, value tables have several advantages. First, they offer transparency. To begin with, they utilize scores in a format that may be more familiar to parents and the general public (e.g., Not Met, Met and Exemplary). In a simple visual presentation, a value table presents numerically the rewards that are assigned to students based on their academic performance at an initial time, and their performance at a second point in time. Second, the summary statistic across all students can be as simple as taking the mean of the values obtained from each student. No complex mathematics or statistical methods need to be employed, allowing a school or district to perform the computations to obtain the summary of their students' academic growth. Finally, because the process is transparent, understandable, and computationally simple, different value tables can be considered by stakeholders with varying levels of expertise regarding student assessment. With discussion, the value table can be altered to reflect the consensus of stakeholders regarding the relative importance of different initial performance/final performance combinations.

The current value table and the rationale for its creation have already been discussed. In light of the relationships among absolute, growth and poverty indices observed using the current value tables, three alternative value tables were created. The first alternative (Table 4) was created with two goals; (1) decreasing rewards for students that maintained their status at successively lower PASS levels, and (2) increasing increments in rewards for gains to successively higher levels. Alternative 1 is a modification to the current value table which makes the pattern of increased rewards for students who maintain their status at successively higher levels uniform throughout the table. Students who maintain their status at Not Met 1 are rewarded with 60 points, and students who maintain their status at Not Met 2 are rewarded with 70 points; with increments of 10 points for students who maintain their status at successive higher levels to 100 points for students who maintain their status at Exemplary 5. Students who increase their achievement by one level are rewarded with an additional 20 points, students who increase their achievement by two levels are rewarded with an additional 25 points; each additional increase in level is rewarded by an additional 5 points. Students who decrease one level receive 15 points less than students who maintain their achievement level, and students who decrease their achievement by two levels receive 10 points less than students who maintain their achievement level; each additional decrease in achievement level is rewarded by 5 points less.

Table 4. Alternative 1

Year One (Pre-test)	Year Two (Post-test)				
	Not Met 1	Not Met 2	Met	Exemplary 4	Exemplary 5
Exemplary 5	60	70	75	85	100
Exemplary 4	60	65	75	90	110
Met	55	65	80	100	125
Not Met 2	55	70	90	115	135
Not Met 1	60	80	105	135	170

The second alternative (Table 5) was created to: (1) provide equal reward for students who maintain their achievement level, and (2) reward gains from one achievement level to the next equally, regardless of the initial achievement level of the student. In Table 5, all diagonal elements have the same value (100) and within any row, the difference between adjacent values is 10 points.

Table 5. Alternative 2.

Year One (Pre-test)	Year Two (Post-test)				
	Not Met 1	Not Met 2	Met	Exemplary 4	Exemplary 5
Exemplary 5	60	70	80	90	100
Exemplary 4	70	80	90	100	110
Met	80	90	100	110	120
Not Met 2	90	100	110	120	130
Not Met 1	100	110	120	130	140

The third alternative (Table 6) was created with a small modification to alternative 2. Students initially scoring at the lowest two levels (Not Met 1 and Not Met 2) receive a larger increment in reward (an additional 10 points) for increasing their achievement one level (120 points rather than 110 points). Increases of two or more levels are rewarded by an additional 10 points. Alternative 3 provides additional incentive for students initially scoring Not Met 1 to increase

their performance to Not Met 2. Students initially scoring Not Met 2 are also provided a larger incentive for increasing their achievement to Met. These larger increments for low achieving students are consistent with the intent in the development of the current value table, which was to encourage low achieving students to improve their levels of achievement to Met or above.

Table 6. Alternative Value 3.

Year One (Pre-test)	Year Two (Post-test)				
	Not Met 1	Not Met 2	Met	Exemplary 4	Exemplary 5
Exemplary 5	60	70	80	90	100
Exemplary 4	70	80	90	100	110
Met	80	90	100	110	120
Not Met 2	90	100	120	130	140
Not Met 1	100	120	130	140	150

Results

Table 7 presents summary statistics for absolute and growth indices that allow a judgment to be made regarding whether results of this investigation can be generalized to an operational setting. For both elementary schools and middle schools in both the 2010 and 2011 report card data, only minor differences exist between the summary statistics obtained from the operational data and the study data. More importantly, the correlations between indices obtained using operational and study data (both absolute and growth) are 0.97 or higher. The similarities of the indices obtained using operational and study data and their high correlations suggest that conclusions drawn from results obtained from the study sample may be used to infer results in an operational setting.

Table 7. Summary Statistics of Absolute and Current Growth Indices using Operational and Study Data.

Index/Data	2010				2011			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Elementary Schools								
Absolute								
Operational	3.06	0.43	1.45	4.66	3.12	0.44	1.38	4.63
Study	3.00	0.44	1.58	4.73	3.04	0.44	1.38	4.64
Current Growth								
Operational	95.80	2.61	84.17	102.91	95.39	2.49	82.88	101.52
Study	95.47	2.80	83.96	104.31	95.37	2.63	82.19	101.47
Middle Schools								
Absolute								
Operational	2.93	0.45	1.61	4.80	2.98	0.48	1.29	4.83
Study	2.92	0.45	1.57	4.80	2.97	0.48	1.09	4.83
Current Growth								
Operational	95.31	2.80	83.94	101.35	95.29	3.09	78.31	101.43
Study	95.19	2.86	84.38	101.40	95.29	3.09	78.31	101.43

Table 8 presents summary statistics for growth indices obtained using the three alternative value tables examined. Differences in all summary statistics presented are to be expected, because the alternative value tables differ with respect to the number of points awarded and the variability in points awarded, especially for students who maintain the same performance level from year 1 to year 2. Alternative 1 awards 60 to 100 points to students who maintain their achievement levels, while alternatives 2 and 3 award 100 points to all of these students. This disparity results in lower means and larger standard deviations for alternative 1. Because alternatives 2 and 3 are similar, their means and standard deviations are also similar.

Table 8. Descriptive Statistics of Growth Indices from Alternative Value Tables.

Value Table	2010				2011			
	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum
Elementary Schools								
Alternative 1	81.79	4.68	66.56	97.59	82.09	4.56	64.06	97.21
Alternative 2	99.72	1.29	95.47	104.52	99.43	1.35	94.88	104.84
Alternative 3	100.98	1.58	96.25	106.15	100.69	1.71	95.18	107.51
Middle Schools								
Alternative 1	81.36	4.93	66.63	100.12	81.85	5.29	59.84	99.50
Alternative 2	100.27	0.96	97.48	103.42	100.22	1.09	96.74	102.53
Alternative 3	101.47	1.06	98.29	105.54	101.46	1.24	96.87	104.20

Table 9 presents the correlations between absolute indices and growth indices and between growth indices and poverty indices for elementary and middle schools, for the three alternative value tables, for the 2010 and 2011 report card years. Some general trends in the correlations can be observed when comparing elementary schools to middle schools, and when comparing correlations in 2011 to correlations from 2010. Correlations are generally higher for middle schools than for elementary schools, most likely because middle schools serve more students and any summary measure that is based on more students will be less susceptible to sampling fluctuations. Correlations tend to be slightly lower for 2011 than for 2010.

A clear pattern also emerges regarding the magnitudes of correlations between absolute and growth indices among the value tables considered. Alternative 1 consistently gives the largest positive correlation, followed by the current value table and alternatives 2 and 3, respectively. The magnitude of correlations between growth indices and poverty indices follow an opposite trend. Alternative 1 consistently gives the largest negative correlation, followed by the current value table and alternatives 2 and 3, respectively.

Table 9. Correlations among Absolute and Growth Indices, and Growth Indices and Poverty Indices for Current and Alternative Value Tables.

Value Table	Absolute with Growth		Growth with Poverty	
	2010	2011	2010	2011
Elementary Schools				
Current	.85	.81	-.56	-.50
Alternative 1	.98	.97	-.76	-.73
Alternative 2	.23	.06	.00	.14
Alternative 3	-.03	-.15	.22	.31
Middle Schools				
Current	.93	.92	-.76	-.68
Alternative 1	.99	.99	-.85	-.81
Alternative 2	.52	.47	-.39	-.29
Alternative 3	.16	.19	-.06	-.01

To understand the pattern of correlations between absolute and growth indices for the value tables presented here consider Tables 10 and 11, which present the percentage of students in each value table location for schools with absolute ratings of Excellent or At Risk. For both

elementary and middle schools a similar pattern emerges; students in schools with an Excellent rating most frequently maintain their PASS rating at the Met or Exemplary 5 levels, and students in schools with an At Risk rating most frequently maintain their PASS rating at the Not Met 1 or the Met level. Similar percentages of students from these schools maintain their status at the Met level. Differences in growth indices obtained for schools by absolute rating, then, depend most heavily on the points awarded for students who maintain their achievement at either the Not Met 1 or Exemplary 5 levels.

Alternative 1 awards 100 points to students whose initial PASS level is Exemplary 5 that maintain this level, and 60 points to students whose initial PASS level is Not Met 1 that maintain this level. As the absolute ratings of At Risk and Excellent would suggest, a smaller percentage of students in schools with ratings of At Risk and a larger percentage of students in schools with ratings of Excellent initially score at the Exemplary 5 level, and a larger percentage of students in schools with At Risk rating and a smaller percentage of students in schools with ratings of Excellent initially score at the Not Met 1 level. As a consequence, students in schools with absolute ratings of Excellent more frequently receive 100 points, and students in schools with absolute ratings of At Risk more frequently receive 60 points. The highest growth indices are then obtained by schools with the highest absolute ratings (and indices), and the lowest growth indices are then obtained by schools with the lowest absolute ratings (and indices).

The current value table has some elements of alternative 1 because fewer points are awarded for students who maintain their status at levels below Met, but does not continue this trend for students who maintain their achievement at the Exemplary 4 and Exemplary 5 levels. As a result, growth indices and absolute indices are not as highly correlated as for alternative 1.

Alternatives 2 and 3 award 100 points to students who maintain their achievement level regardless of what that level may be, enabling schools with absolute ratings of At Risk to obtain growth indices similar to those obtained by schools with absolute ratings of Excellent. Correlations between growth indices and absolute indices are substantially lower than are correlations from the current value table or alternative 1. Recall that alternative 3 differs from alternative 2 in a small way; it awards more points to low achieving students who increase their achievement. This small difference accounts for the differences between the correlations for these value tables.

Table 10. Percentages of Students in Most Frequently Filled Cells in Value Table for Elementary School Students in Excellent (E) and At Risk (AR) Schools.

Year One (Pre-test)	Year Two (Post-test)				
	Not Met 1	Not Met 2	Met	Exemplary 4	Exemplary 5
Exemplary 5				E (5)	E (24)
Exemplary 4			E (6)		E (6)
Met		AR (7)	E (23) AR (20)	E (5)	
Not Met 2	AR (10)	AR (10)	AR (9)		
Not Met 1	AR (21)				

Table 11. Percentages of Students in Most Frequently Filled Cells in Value Table for Middle School Students in Excellent (E) and At Risk (AR) Schools.

Year One (Pre-test)	Year Two (Post-test)				
	Not Met 1	Not Met 2	Met	Exemplary 4	Exemplary 5
Exemplary 5					E (20)
Exemplary 4			E (5)	E (6)	E (8)
Met		AR (9)	E (23) AR (19)	E (7)	
Not Met 2	AR (9)	AR (9)			
Not Met 1	AR (23)	AR (7)			

Discussion

The current growth indices were created using a value table that was designed to reward schools for moving student performance to the Met level which is defined in the EAA as “meeting standard.” An unintended consequence of the current value table has been to increase the correlation or dependency of the absolute and growth indices. If students initially scoring less than Met on PASS most frequently improved one level rather than most frequently maintaining the same level, the correlation between absolute and growth indices would be likely minimized. With the current value table, both absolute and growth indices are also related to socio-economic status as measured by the poverty index. When both measures are related to the poverty status of the school or district, they are no longer providing separate information regarding the educational status and progress of schools or districts. This analysis will assist the Education Oversight Committee when the accountability system is reviewed again in 2013.

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