The Roger Bacon Academy

Multi-Measure Growth Graph - MMGG

Background: When comparing schools or classrooms or curricula, evaluators have been faced historically with a choice of one or two measures of growth such as average growth per student and ratio of students achieving positive growth or they have faced a dizzying array of numbers in a huge incomprehensible table of scores.

The Roger Bacon Academy has devised a visual representation for evaluating year-to-year academic growth that pictorially displays several aspects of academic growth for a number of students in a manner that allows a fair comparison between instructional groups – be they schools, grades, classes or teachers.

The pictorial representation requires no new tests. Instead it uses available year-to-year pre- and post-data such as End of Grade scores, SAT 10 scores, or any tests of academic achievement that are available for the time period over which growth is being evaluated.

Growth: In North Carolina, the goal for each student is that the student achieve one year's growth in one year's time. That is, a student whose 3rd grade reading score is at the state mean should achieve a 4th grade reading score also at the mean. The student has moved up a full grade and retained his ranking with the grade on a state-wide basis. Likewise, a student who scores ½ standard deviation (SD) below the mean in 3rd grade must score at least ½ SD below the mean in 4th grade to achieve the one year's growth in one year's time. Similarly, a 3rd grade score that is 1.2 SD above the mean will require a 4th grade score also 1.2 SD above the mean. Many arguments can be made about the adequacy of this process as a desirable goal-setting method, but the purpose of this paper is deal with what exists, not revise the current scheme.

Performance: The other metric used by evaluators is "performance" which classifies each student's score into some number of categories relative to criteria that set a certain standard for being "at grade level" in a certain subject. Currently, North Carolina has four categories designated 1, 2, 3, and 4 where 1 and 2 are below grade level and 3 and 4 are above grade level.

Multi-Measure Growth Graph - MMGG: As mentioned above, taking a school's or class's year-to-year score gains in a number of academic subjects across several grades involving hundreds of students and comparing this array with another school or class is a daunting task.

To aid in this evaluation process, The Roger Bacon Academy has devised what it is calling a "multi-measure growth graph" or MMGG – four examples of which are shown below.

The Axis's: The horizontal axis is a scale of the pre-test as normalized for some population of test-takers. In the case of the EOG tests, the horizontal axis depicts the the c-score (the scaled score minus the mean divided by the standard deviation) from -2.5 SD to +2.5 SD for the prior year's test in a particular subject. See Fig. 1. In the case of the SAT 10, the axis would depict the percentile scores expressed as NCE's as shown in Fig. 3.

The vertical axis is the same, but is for this year's EOG c-score or SAT 10 NCE.

The Black Plotted Point: Each dot on the MMGG represents a particular student whose dot is drawn at the intersection of the student's two scores. Thus if we are depicting the academic achievement of a grade level in a school for reading, there may be a hundred dots on the graph. A single class may have 20 to 30 dots.

The Red Growth Goal Line: Referring to Fig. 1, notice that the red line shows the NC growth goal of one year's growth in one year's time. Any dot lying on the red line represents a student who has exactly met the goal. All dots above the red line show students who surpassed the goal. Likewise all dots below the red line show students who did not achieve one year's growth in one year's time.

The Green Performance Lines: Referring again to Fig. 1, the green lines are set at the boundaries of the grade-level criteria dividing a below grade level score from a grade level score. Any dot to the left of the vertical green line represents a student who scored below grade level in the pre-test. Dots to the right show students who were at or above grade level in the pre-test.

The horizontal green line separates grade level scores for the post test.

Dots in the upper right quadrant of the green lines represent students who scored at or above grade level for both pre- and post-tests. Dots in the lower left quadrant show students who passed neither test.

The Black Best-fit Line: The black line through the collection of dots represents the best-fit to a line that lies within the center of the dots. It is known as a "least-squares fit" in statistics and indicates the trend for the collection of data points to which it is fitted. In the upper right, the linear equation of this line is shown along with the square of the correlation coefficient R. Notice in Fig. 1 R^2 = .7157 so R = .75 which is a very good correlation for the data points to the line.

Discussion and Analysis:

Example for EOG Reading: Fig. 1 shows School A's entire 4^{th} grade reading progress by plotting each student's 4^{th} grade EOG reading c-score versus his 3^{rd} grade c-score. Notice that the students depicted in the lower left showed, in general, more than one year's growth because their dots are above the red one-year line.

Conversely, looking at the upper right quadrant we see that the students' scores cluster below the red one-year line which indicates that although they passed the tests in both years, they did not grow further up in the distribution.

Fig. 2 shows the same data for School B. However, School B shows an average of slightly more than one year's growth in the upper right quadrant; with an insignificant decrease in the lower left. We might

conclude that School B did slightly better with the higher achieving students than did School A, but that School A did better with the lower achieving students. If both schools are using the same reading curriculum, we would have to examine other factors to account for this difference in overall results. Perhaps School A was devoting more resources to their Tier 2 and Tier 3 students, for example.

Example for Stanford Achievement Test Math: Fig. 3 show's School A's 3rd grade class for their SAT 10 math scores plotted against their 2nd grade math scores. We can see that on the SAT 10 test, the grade as a whole far surpassed one year's growth in one year's time.

Likewise, School B in Fig. 4 showed a very similar pattern with all students demonstrating more than a year's growth.

In both cases the correlation coefficients are very good; and the lower achieving students show, in general, more acceleration than the higher students indicating that they may be catching up.

Conclusion:

The MMGG is still evolving with additional metrics such as total growth and % passing being displayed. These pictorial representations are being well received and understood by teachers and coaches and helping to compare schools, curricula, and teachers in their various subjects.

Fig. 1 Growth in EOG Reading Score during 4rd Grade - School A

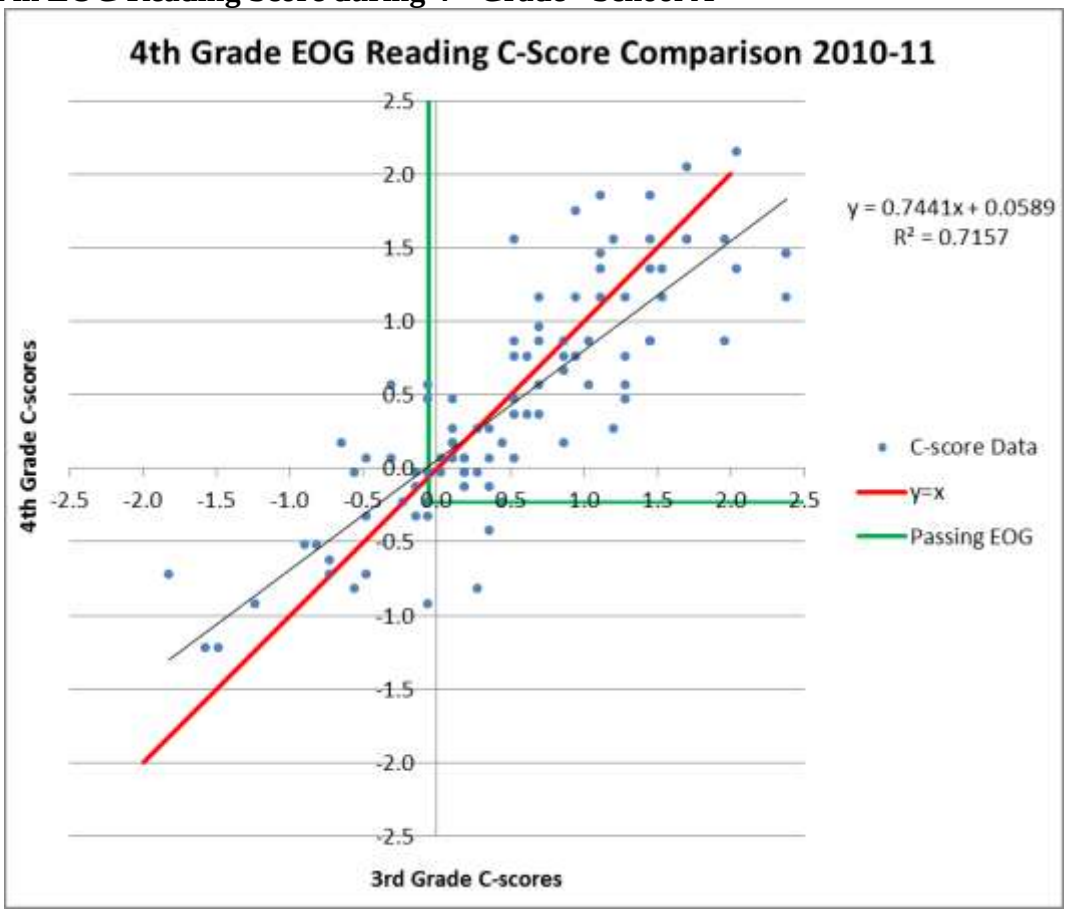

Fig. 2 Growth in EOG Reading Score during 4rd Grade - School B

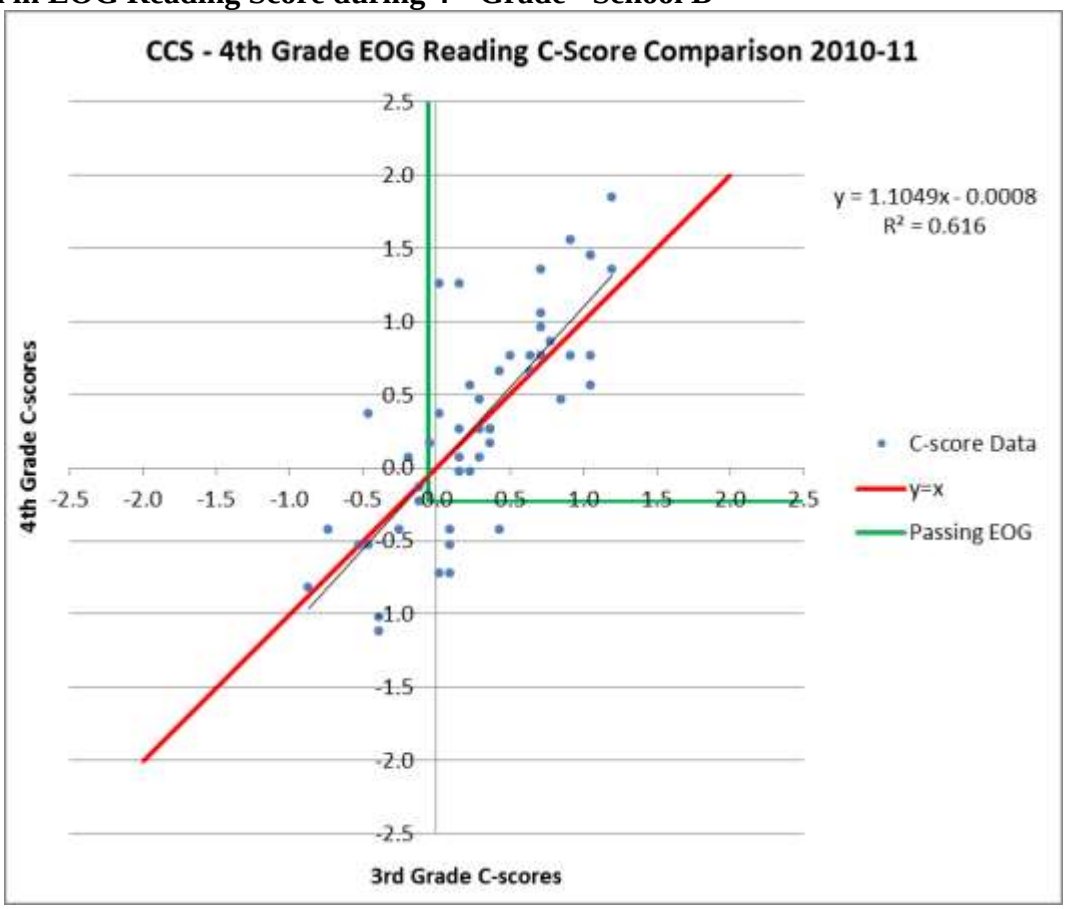

Fig. 3 Growth in SAT 10 Math Score during 3rd Grade – School A

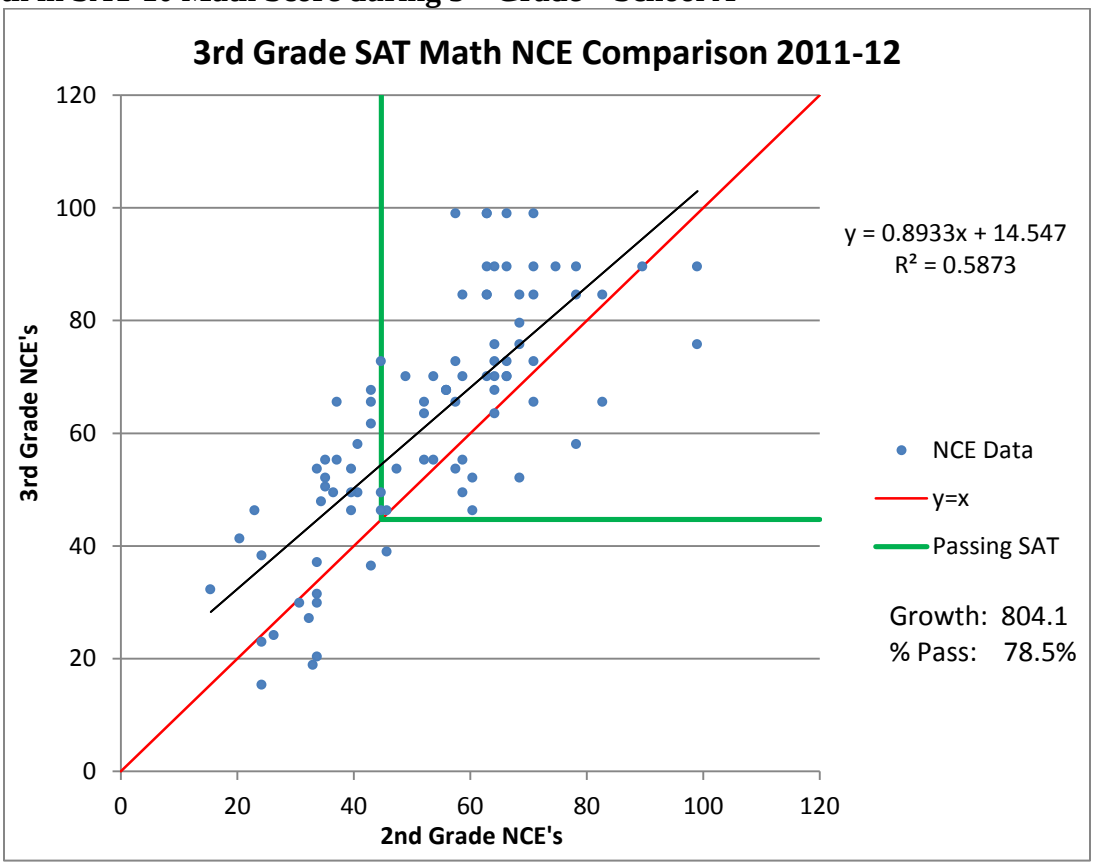

Fig. 4 Growth in SAT 10 Math Score during 3rd Grade – School B