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Commission Staff Research Report

Growth Models: An examination within the context of NCLB

Since President Bush signed the No Child Left Behind Act (NCLB) into law in early 2002, interest and discussion over tracking growth in achievement, or using growth models, has increased tremendously. Growth models have been used for some time in social sciences and program evaluation. Now, a very vocal segment of the education policy and advocacy communities, as well as many state and local educators, have argued for measuring the academic growth students achieve from year to year in NCLB. While NCLB currently mandates the use of a status model, many of these individuals are interested in either replacing the status model with a growth model, or using growth as an additional factor in the status model. A status model (as used under NCLB) looks at a subgroup's or school's level of proficiency for a specific year or average of several years. This level of proficiency is then compared to an established target.

This paper examines how a longitudinal growth model – one that tracks the achievement of individual students, rather than cohorts of students – would impact NCLB. Included is a discussion of the necessary data components as well as an examination of the benefits and disadvantages of incorporating and utilizing this type of model. Lastly, the paper includes a brief discussion of two growth model pilot programs recently approved by the U.S. Department of Education in Tennessee and North Carolina.

Growth models give schools credit for student improvement over time.

Growth Models

What is a growth model? Growth models generally refer to models of accountability that measure progress by tracking achievement scores of the same students from one year to the next with the intent of determining whether or not students have made progress. There are many different kinds of growth models including the commonly referenced "value-added" model. A value added model takes into account not only growth, but other background characteristics in determining progress or the effect of a particular program or intervention.

Growth models give schools credit for student improvement over time. These models assume that student performance is not simply a matter of where the school's academic achievement is at any single point in time. Growth models assume a school's ability to facilitate progress is a better indicator of its performance.[1]

[1] CCSSO, *Policymakers' Guide to Growth Models for School Accountability: How Do Accountability Models Differ?* (Washington, DC: CCSSO, 2005), 4.

Components Necessary to Implement Growth Models

There are several components necessary to implement growth models. In written testimony before the Commission, Aimee Guidera, the director of the Data Quality Campaign, outlined several different elements needed in order create a longitudinal data system necessary to implement a growth model.

1. A unique statewide student identifier.
   In order to measure growth, a state has to have the ability to track individual student scores from one year to the next and one school or district to the next if the student moves. In order to track students, each student needs to be assigned a single, non-duplicated number that remains with a student throughout his or her PreK-12 career.[2]

2. The ability to produce comparable results from grade to grade and from year to year (Vertically-scaled assessments).
   States need assessments that are designed to produce comparable results from grade to grade and from year to year so that growth can be measured properly. Assessments should be developed such that scores on any two adjacent grades can be subtracted in order to compute an estimate of the amount that a student has grown from one year to the next.[3]

3. Student-level enrollment, demographic and program participation information.
   Program participation information is important to collect in order to examine student participation in programs such as special education and free and reduced lunch. Accurate enrollment information is essential in evaluating the impact of student programs on different populations of the school.

4. Information on untested students.
   This information should be collected in order to track trends and identify patterns of untested students of certain subgroups (such as students with disabilities and English language learners). Information on untested students is important as it will inform policymakers and educators on whether or not particular schools and districts have excessive absences on test day or questionable patterns of absences and exemptions across years.

5. Student level graduation and drop-out data.
   In order to calculate graduation rates according to the National Governors Association Compact, states need to collect data on students beginning in the 9th grade.[4] The NGA Compact was signed by all 50 Governors and compels states to take steps to implement a standard, four-year adjusted cohort graduation rate. Under the Compact, states agreed to calculate the graduation rate by dividing the number of on-time graduates in a given year by the number of first-time entering ninth graders four years earlier. This calculation would be adjusted for transfers

[2] Aimee R. Guidera, *Testimony before the Commission of No Child Left Behind Act*, (Testing: Making It Work for Children and Schools, West Hartford, CT, May 9, 2006), p. 3.
[3] CCSSO, p. 8.
[4] Data Quality Campaign, *The 10 Essential Elements in Detail for 2005-06*, [on-line]; available from http://www.dataqualitycampaign.org/activities/elements.cfm#element1; Internet, accessed 27 July 2006.

in and out of the system. Information should also be collected on when and why students leave the state-wide system. Graduates are defined as those receiving a high school diploma.[5] Special education students and recent immigrants with limited English proficiency can be assigned to different cohorts to allow them more time to graduate.

6. State-wide audit system.
   An audit system is necessary in order to assess data quality, validity and reliability. Invalid or unreliable reporting by some schools and districts is a problem in a number of states, and this problem can likely be corrected by implementing a state audit system. An audit system will help prevent invalid and unreliable reporting and will build public confidence in the accountability system.[6]

Additional Components to Incorporate into Value-Added Models

Those wishing to implement a value added model for the purposes of assessing teacher quality or other aspects would have to include the following additional components to those described above.

1. A teacher identifier system.
   A teacher identifier system will develop the ability to match teachers to students. Collecting this data makes it possible to identify which students and which courses are being taught by teachers with different levels and types of preparation or certification, and which teachers have the greatest impact on students' academic growth in the classroom.

2. Student-level transcript information.
   Collecting information on courses completed and grades earned allows the state to monitor the number of students in different subgroups enrolling in different classes. Transcript information also allows states to detect grade inflation and differences in rigor from school to school. Examining transcript information allows schools to track possible trends such as students in an Algebra class all receiving above average grades, but only a small percentage actually scoring proficient on the State assessment.[7]

Advantages, Disadvantages and Challenges of Growth Models

As with other accountability metrics, growth models have both advantages and disadvantages. Longitudinal growth models are generally designed to give credit to schools for the progress they make regardless of their distance from a set target or goal. These models also compare and track the same students from year to year, and therefore reduce errors due to the mobility of students, the reassignment of teachers, or other internal school factors.

> Many educators feel that the achievement status of a school is not a sufficient indicator of success.

[5] National Governors Association, *A Compact on State High School Graduation Data*. [on-line]; available from http://www.nga.org/Files/pdf/0507GRADCOMPACT.PDF; Internet, accessed 27 July 2006.
[6] Data Quality Campaign, [on-line].
[7] Ibid.

Value-added models also enable educators to identify changes in learning that are due to school, curriculum, or teacher effectiveness.[8]

Many educators feel that the achievement status of a school is not a sufficient indicator of success. A significant amount of public input and testimony at Commission hearings has favored measuring growth either as an element in an accountability system or as the sole factor. This was often cited as more fair than current systems, and that local staff would be more willing to be held accountable for the growth a student makes as a result of instruction provided by the school rather than have the school rated on the prior instruction the student received.[9]

Growth models also add considerably to the size and capacity of a state accountability system, which may compel states to provide greater and better technical assistance and support to struggling schools. These models also enable educators to better identify performance problems enabling strategies to be developed to ensure that low-performing students receive the programmatic help necessary to improve their performance.[10]

There are, however, some disadvantages associated with the production and use of growth models. A major disadvantage of growth models is that while they do allow states to identify movement toward proficiency, they could also imply that only positive growth (sometimes no matter how much) is important and that schools are not expected to have all of their students perform at a proficient level.[11] The questions which some growth models force are how much growth is enough; and will that growth be sufficient to reach academic standards now or in the future?[12]

Mark Davison from the University of Minnesota addresses this issue with the concept of a student being "on track." On track is defined by whether the rate of growth from last year to this year is sufficient to meet future proficiency targets if this rate of growth continues. The growth model approved by the U.S. Department of Education for North Carolina uses the concept of "on track" by having students that are not proficient average a 25% percent closure in the gap between their current achievement level and proficiency each year for four years in order for these students to be deemed proficient (see example in the Appendix). Each year a student is counted as proficient if that gap is reduced by at least that percentage.[13]

Growth models also add considerably to the size and capacity of a state accountability system…

The current model used to measure AYP holds schools, districts, and states accountable for the learning of all students, using the same bar of measurement; however, growth models do not require a universal goal. Also, if a growth model is not implemented with precision and accuracy, the model could improperly place fault for declining or stagnant

[8] Rolf Blank and Lori Cavell, *Memorandum to Chief State School Officers: Growth Models Primer,* (Washington, DC: CCSSO, 2005), 3.
[9] CCSSO, p. 9.
[10] Blank and Cavell, p. 3.
[11] Ibid.
[12] Mark L. Davison and Leslie J. Davison, *Growth and Value-added Issues in Minnesota,* (Minnesota: Department of Educational Psychology and Office of Educational Accountability, University of Minnesota, 2005), p. 9-10
[13] Ibid., p. 9.

levels of student growth on teachers, programs, or schools.[14] In short, accuracy in the use of data and its creation is critical to the use of a growth model.

There are also several challenges that should be considered when preparing and implementing growth models. In order to implement a growth model, many states will have to significantly enhance their existing assessment and data systems. In order to measure student growth, states must have: annual assessments in successive grades; student identifiers that allow for individuals to be tracked over time and from school to school; vertically-scaled or aligned assessments and grade-specific performance standards; and at least two years of data. All of these requirements will involve extensive hours of development and training of people to interpret and report the results. The data system requirements offer the most important challenges to the implementation of growth models because of the large demand in resources.[15]

Growth models are likely to be more complex to implement and maintain than status models. When preparing to implement a growth model, states may have to wait two or more years before they can acquire enough data to assess growth from one year to the next. Another challenge in the implementation of a growth model is setting the actual growth standards – essentially defining how much growth is sufficient to be deemed acceptable. States would have the responsibility of going through the standard setting process to establish AYP standards for both growth and status. If this process can be integrated into an already budgeted standard setting process, there may not be major additional costs. However, if the status standards are set, a state should estimate that setting growth standards may require additional resources as well.

Another challenge is the availability of psychometric staff and expertise. Psychometric staff are trained to resolve challenging technical issues. If the states have effectively trained this staff, there may be little additional costs; otherwise, this resource must be obtained or developed.

Data system requirements may also be another challenge. In order to measure growth, there must be a capacity to track individual student scores from one year to the next. This capacity usually requires a statewide identification (ID) system. If the state already has an individual ID system or has budgeted for the development of an individual ID system, then there would not likely be any additional costs to use that system for the growth model. It is much more difficult to determine growth without a statewide ID system, and if one is not in place, establishing one would be a barrier to implementing such a system.

An additional challenge is providing the training required to build capacity among the teachers, administrators, media, legislators, and general public to understand the additional complexities that occur when using data from more than one point in time.[16] It is essential to have on-going professional development of people who collect, store, analyze, and use the data produced through growth models. The local school employee who inputs course grades needs to fully understand how this task fits into the larger picture of data systems. The principal needs to understand how data can affect daily school management and academic decisions. Policymakers need to understand how the

[14] Blank and Cavell, p. 3.
[15] Ibid.
[16] CCSSO, 8

expansion of data can increase their ability to be able to analyze information and make better decisions.

Growth Model Pilot Program

NCLB does not currently envision growth models, as described in this report, to be used to calculate AYP for NCLB. While NCLB does not bar a state from using a growth model, they are not allowed as an element in determining AYP. Recent administrative action by the U.S. Department of Education has removed these barriers by allowing two states to implement growth models.

In the summer of 2005, the Department of Education began a series of meetings designed to inform Department officials on the guidelines necessary for growth models that they deem would meet NCLB requirements. In November 2005, Secretary Spellings announced a growth model pilot program allowing up to 10 states to develop and implement growth model accountability systems that follow certain key NCLB principles highlighted by the U.S. Department of Education. States had until the end of February 2006 to submit their proposed growth models. In order to qualify for this pilot program, growth models must:

1. Ensure that all students are proficient by 2014 and set annual goals to ensure that the achievement gap is closing for all groups of students;
2. Set expectations for annual achievement based upon meeting grade-level proficiency, not based on student background or school characteristics;
3. Hold schools accountable for student achievement in reading/language arts and mathematics;
4. Ensure that all students in tested grades are included in the assessment and accountability system, hold schools and districts accountable for the performance of each student subgroup, and include all schools and districts;
5. Include assessments in each of grades three through eight and high school in both reading/language arts and mathematics, must have been operational for more than one year, and must receive approval through the NCLB peer review process for the 2005-06 school year. The assessment system must also produce comparable results from grade to grade and year to year.
6. Track student progress as part of the state data system; and
7. Include student participation rates and student achievement on a separate academic indicator in the state accountability system.[17]

The Department received 20 applications by states to participate in this growth model pilot program. Eight of these applications were forwarded to a peer review panel created by the Department to assess their quality and compliance with the Department's principles. The peer review panel approved two states, North Carolina, and Tennessee, to participate in this pilot project for the 2005-2006 school year. The other 6 applicants which were included in the peer review process were encouraged to apply early in the 2006-2007 school year.

[17] U.S. Department of Education, *Growth Models: Flexibility and Accountability* [on-line]; available from http://www.ed.gov/admins/lead/account/growthmodel/factsheet.html; Internet, accessed 27 July 2006.

Analysis of North Carolina and Tennessee's Growth Models

As stated above, upon completion of the peer review process, two states, North Carolina and Tennessee, were chosen to implement their growth models for the 2005-06 school year. Below is an analysis of each state's model. It is important to note that each state has a different and distinct growth model. In addition, each state will not be exclusively using a growth model to determine adequate yearly progress for each school. The states will be using a blended model that incorporates both the status model as well as a growth model.

North Carolina

North Carolina has built a growth model using a four-year growth trajectory for students. The four-year growth trajectory created for each student will use a student's starting point (initial test score – also thought of as a pretest score) and hopeful ending point (a test score for proficiency at some future point in time) to determine if the student's actual scores in the interim are at or above that trajectory. The student's initial score for most third graders is the pretest administered at the beginning of the third grade. For other grades, the end-of-grade (EOG) or end-of course (EOC) assessment from the previous year is used as the pretest. The target is the score on the state's growth scale that is equivalent to the passing score on the test administered four years after entry into the tested grade. Each year, the trajectory target is a 25% decrease in the difference from the pretest score on the state's growth scale to the score necessary to be proficient on the test in four years. Using this method, a student's position on a trajectory path could be determined and documented as on- or off-trajectory in any given year.[18]

Under North Carolina's program, students who are lacking the necessary pretest scores or who use alternate assessments that are not on the growth scale have their participation limited to their absolute status. It is important to note that proficient students are not included in growth trajectories for AYP purposes. A student who scores proficient is weighted the same as a student who is on target. In this way, the growth of high-performing students does not compensate for the lack of growth among other students.

As the state replaces tests with new editions, the conversion between the state's growth scale and the required performance for proficiency in a certain grade will be determined. As a part of this process, the state standard for trajectory will be reviewed and modified to meet the needs introduced by the change in test edition.

[18] North Carolina Department of Public Instruction (NCDPI)/Accountability Services, *North Carolina's Proposal to Pilot the Use of a Growth Model for AYP Purposes* (North Carolina: NCDPI/Accountability Services, 2006), p. 3.

Table 1. Grades And Tests Used For Trajectory Growth And The Percent Of Closing Expected Per Year

Grade Of First Enrollment	Test Used As The Basis For Prediction	Test Used As Target For Proficiency	Years In Trajectory	Percent Of Difference Closed Per Year
3	3rd grade pretest	6th grade EOG	4	25%
4	3rd grade EOG	7th grade EOG	4	25%
5	4th grade EOG	8th grade EOG	4	25%
6	5th grade EOG	Algebra I or English I EOC	4	25%
7	6th grade EOG	Algebra I or English I EOC	4	25%
8	7th grade EOG	Algebra I or English I EOC	3	33%

Source: NCPDI Proposal to Pilot the Use of a Group Model for AYP Purposes in 2005-06

The trajectories are individually constructed for students and include separate goals for reading and mathematics. Therefore, a student will have a trajectory created from their baseline mathematics score and reading score and will have separate scores required to be considered proficient for mathematics and reading. In the upper grades, Algebra I is the assessment used for AYP purposes for 10th grade students and is the trajectory target for math while an English I assessment is the trajectory target for reading/language arts.

No plans are currently in place to report individual student growth scores to parents. The reason for doing so is based on the state's decision to not report individual results to parents in any terms other than status on the developmental scale, achievement level and achievement level descriptors. However, the state will report AYP group level growth results as part of the public AYP reporting.

Tennessee

According to the Tennessee Department of Education's Proposal for the NCLB Growth Model Pilot Program, an annual projection for each student is made using all available past scores for a student. The state's projection model relies on a statistical methodology that uses all of an individual student's prior achievement scores to estimate the student's achievement level at a future point in time. The methodology has been in use in Tennessee since 2002, when the state began reporting individual student projections on future assessments to inform instructional decisions.

By assuming that the student will have the average Tennessee schooling experience in the future, the model includes estimated mean scores for the average school in Tennessee and regression coefficients that are pooled within schools across the state. These coefficients

are updated each year as a new student cohort acquires test scores at the projection endpoint.[19]

For example, in order to find a 6th grade student's projected score on the high school English II exam, the statistical methodology uses scores from students who took the English II exam in the current year who have the same historical pattern of test scores as the 6th grade student. If the student has 3rd grade, 5th grade, and 6th grade scores (but no 4th grade scores), the methodology estimates regression coefficients for these scores based on the subset of students who took the English II exam in the current year who also had 3rd grade, 5th grade, and 6th grade scores (but no 4th grade scores). These coefficients are then applied to the individual student's 3rd, 5th, and 6th grade scores to calculate the student's projected score on the English II exam. If the student has made progress between the 3rd and 6th grade, the model will show if this progress has been sufficient to predict that the student will reach proficiency by the time he or she takes the English II exam.

The projection model has the same standards as the current status model. Schools and districts may meet AYP proficiency requirements under the projection model only under the following conditions:

1. Each subgroup's projected percentage of students who score proficient or advanced on reading/language arts meets the approved annual measurable objective for reading/language arts; and

2. Each subgroup's projected percentage of students who score proficient or advanced on mathematics meets the approved annual measurable objective for mathematics.

The projection model assigns school credit for all students who are projected to be proficient three years into the future, whether they are currently below proficient or are currently proficient. It does not assign schools **any** credit for students who are currently proficient but are projected to score below proficient on the future assessment. It does not assign schools any additional credit for students who have advanced scores.

The projection model includes current scores for 3rd grade students and other students who are in their first tested year in Tennessee. If the student scores at a proficient level in the current year (year in which the student entered the system), he or she will be counted as proficient in the projection model. If the student scores below proficient in the current year, he or she will be counted as below proficient in the projection model.[20]

The projection model will include all elementary/middle school students tested under the Tennessee Comprehensive Assessment Program (TCAP). Once students reach high school, the projection model will not apply and the status model will be used in its place because a projection cannot be made for three years into the future for high school assessments. The table below lists the proficiency definition for each student by category.

[19] Tennessee Department of Education (TDE), *Proposal to the U.S. Department of Education: NCLB Growth Model Pilot Program*, (Tennessee: Tennessee Department of Education, 2006), p. 6.
[20] Ibid.

Table 2: Projection Model Proficiency by Student Category

Student Category	TCAP Score Applied	Proficiency Standard
3rd grade	3rd grade	3rd grade
4th grade	7th grade projection	7th grade
5th grade	8th grade projection	8th grade
6th -8th grade	High school projection	High school
With no prior test score	Current score	Current grade
Who take alternative assessments	Current score	Alternative standard

Source: Tennessee Department of Education NCLB Growth Model Pilot Program Proposal

These criteria set a limited time frame for students to attain proficiency. The model expects fourth and fifth grade students to make accelerated progress towards attaining proficiency by the seventh and eighth grade, respectively. It expects sixth through eighth grade students to make accelerated progress to attain proficiency by the time they take the high school graduation exams for math and reading/language arts, typically during the ninth or tenth grade. This path expects that each student will make substantial progress – much more than a year's worth of progress – every year until proficiency is attained. By expecting students in the greatest need to make the most progress, the proposed model is designed to drive the elimination of student achievement gaps.[21]

In order to inform parents of individual student growth, the state will report longitudinally-linked individual student achievement data, including projections to future assessments, to each student's district, school, and teachers via a secure website that makes a printable version available for distribution to parents. The projections show each student's predicted score on all future state assessments, by subject and grade, in comparison to the state's standards for proficient or advanced. The projections also show each student's predicted score on the ACT assessment, by subject and composite, in comparison to ACT college-readiness benchmarks. The state provides training to educators to assist them in using this data to improve instruction and identify students in need of extra assistance to meet state standards.

Potential Impact of North Carolina and Tennessee Proposals

Many advocates of using growth models as an accountability system believe that they will significantly decrease the number of schools that do not make AYP. Based on North Carolina's proposed growth model, if the state used the model in the 2004-05 school year, an additional 40 schools would have made AYP (of the 932 schools that missed under the status model). Under the Tennessee proposal, there was a difference of 47 schools that would have made AYP using a growth model (of the 353 that missed under the status model).

[21] Ibid., 11.

Conclusion

In order to build and utilize a growth model system, several different components must be developed such as unique state-wide student identifiers, the ability to compare results from grade to grade and year to year, student demographic and enrollment information, information on untested students, student level graduation and drop-out data, and a state-wide audit system. In addition to developing these components, a state must have several years of assessment data collected before being able to implement a growth model.

Despite the possibility of being complex and resource heavy to implement, the additional information that states, districts, and schools will be able to collect from growth models could be an extremely powerful tool for school improvement. The data created through a growth model approach could not only be used to hold schools accountable, but also to inform teaching, improve management practices and policy and most importantly, construct targeted interventions to increase student achievement.[22]

[22] Guidera, p. 6.

Appendix

Example of How a Student Is Determined to be on the Trajectory in North Carolina

A student enters North Carolina in the 3rd grade (the day before testing) and remains for the next two academic years. The student scores below proficient in the current school year in reading. This student's known test scores are listed below.

Grade	3 Pretest	3 EOG	4 EOG	5 EOG
Developmental Score	Not in NC	220	229	241
C-scale score		-3.08	-2.68	-1.98

Since the student's first full year in the state is the fourth grade year, the student will need to be on trajectory to be proficient by the end of the seventh grade and thus on the seventh grade EOG assessment for reading. The developmental score for seventh grade reading equivalent to proficient is 252. The associated c-scale score is -1.00. A c-scale score is a number converted from developmental or discrete scales of the EOG AND EOC tests used in order to accurately measure growth.

Since the student entered the state in time for the third grade test, the third grade EOG score will be used as the baseline. The difference between baseline and proficient on the seventh grade test in terms of c-scale scores is 2.08 (3.08 minus 1.00). For the current year (fifth grade, the second year in the state), the student must perform well enough on the test to have 50% less difference between the c-scale score for proficiency and his baseline (3rd grade EOG) c-scale score (divide 2.08 by 2).

For this to be true, the student would need to score at least -2.04 (take 3.08 minus 1.04). The student's actual c-scale score is -1.98 which means the student met the standard to be deemed on trajectory for the current year and thus will be included in the percent of students on trajectory or proficient for AYP calculations. (Notice that the target to count as being on trajectory for this student would have required him/her to have scored at least a -2.56 at the end of the fourth grade. The student's c-scale score was -2.68 and, therefore, this same student was not on trajectory the previous year).

Example of the Process of Creating a Trajectory in Tennessee

To arrive at a 6th grade student's projected score on the high school English II exam, the statistical methodology employed by Tennessee uses scores from students who took the English II exam in the current year who have the same historical pattern of test scores as the 6th grade student. If the student has 3rd grade, 5th grade, and 6th grade scores (but no 4th grade scores), the methodology estimates regression coefficients for these scores based on the subset of students who took the English II exam in the current year who also had 3rd grade, 5th grade, and 6th grade scores (but no 4th grade scores). These coefficients are then applied to the individual student's 3rd, 5th, and 6th grade scores to calculate the student's projected score on the English II exam. If the student has made progress between the 3rd and 6th grade, the model will show if this progress has been sufficient to predict that the student will reach a proficient level of performance by the time he or she takes the English II exam.

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