DATA QUALITY CAMPAIGN
Using Data To Improve Student Achievement

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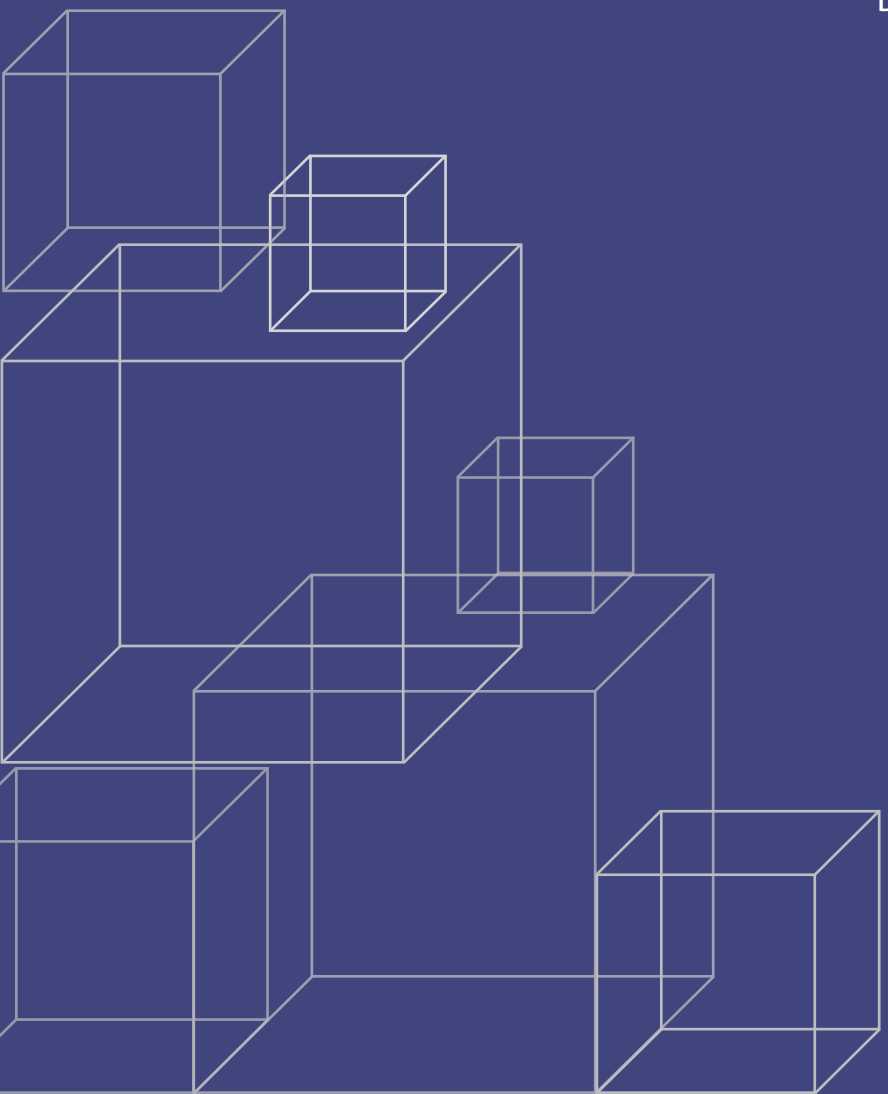
The Power of Longitudinal Data

Measuring Student Academic Growth

By Chrys Dougherty, Ph.D.



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The Data Quality Campaign is a national, collaborative effort to encourage and support state policymakers to improve the collection, availability and use of high-quality education data and to implement state longitudinal data systems to improve student achievement. The campaign aims to provide tools and resources that will assist state development of quality longitudinal data systems, while also providing a national forum for reducing duplication of effort and promoting greater coordination and consensus among the organizations focusing on improving data quality, access and use.

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The Need for Growth Models

The accountability mandates of the No Child Left Behind (NCLB) Act have focused educators' and policymakers' attention on developing fairer and more accurate methods of assessing student progress on academic standards. NCLB requires schools and districts to make adequate yearly progress (AYP) — a measure of the percentage of students meeting academic proficiency in reading (or English/language arts) and mathematics. Yet students in some schools start so far behind that even though they are making progress toward proficiency, they have not met the goal yet. Growth models can give schools credit for this progress. Growth models also can draw attention to the growth among students who already are proficient or advanced.

Currently, most states rely on "snapshot" data to report annual changes in academic achievement of students and schools.[1] Although snapshot data — information that is captured at a single point in time — provide details about students' current academic achievement levels, the information provides limited ability to measure the accomplishments of a school. A school might be effective at increasing achievement for low-performing students even though its overall percentage of proficient students may be low. For example, School A may have lower proficiency levels than School B. But School A may have started with many low-performing students who are increasing their achievement but not yet meeting proficiency. Students in School A may improve their performance more rapidly than those in School B but still have lower achievement levels because they started further behind.

Advantages of Growth Models

Growth models resolve many of the limitations of snapshot data. They measure the academic progress of *the same students from year to year* to determine whether or not students have made progress. For example, learning growth is measured by comparing the performance of this year's 4th graders with the performance of the same students when they were in 3rd grade. Growth models can give schools credit for student improvement over time — even if some students have not reached proficiency. They also let educators know if students are on track for success. On track means that the student's rate of growth from last year to this year is enough to meet proficiency targets if the rate of growth continues.[2]

Value-added models are one type of growth model. These models calculate *predicted* scores for students while statistically controlling for prior achievement (and often for student background characteristics as well) to identify whether students who are in a particular school or program or have a particular teacher perform better than what is typical or predicted for students in their circumstances. However, achieving better-than-predicted growth still may not be sufficient to put a low-achieving student on track toward proficiency or college readiness.

Growth models have several other advantages. They can be used to:

- Identify whether students who are academically behind are growing rapidly enough to get on track if the current rate of growth is sustained.

[1] MPR Associates and the National Center for Educational Accountability, *Judging Student Achievement: Why Getting the Right Data Matters,* Austin, TX, 2005, p. 2.
[2] M.L. Davidson and L.J. Davidson, *Growth and Value-Added Issues in Minnesota,* University of Minnesota, Department of Educational Psychology and Office of Educational Accountability, 2005, pp. 9–10.

- Assist teachers in setting growth targets for individual students.
- Identify unusually effective schools. Schools with traditionally high average scores may not be the schools in which the most learning is taking place. The students already may be high achieving when they enter the school. On the other hand, some schools with apparently mediocre averages may be doing a good job of bringing up the students who are the furthest behind. Once schools of high and average effectiveness have been identified based on student growth, researchers can study how practices differ in the two sets of schools.
- Compare the academic growth of students taught by graduates of different teacher preparation and training programs.
- Provide information for incentive systems to encourage higher-performing teachers to work in high-poverty schools.

In summary, growth models assess and report individual student learning and track this learning over time. They take into account students' entering learning levels to show academic growth rates for initially low-, middle- and high-achieving students. Value-added growth models can compare students' actual and predicted scores, based on prior achievement, to identify effective schools, programs and teachers.

Longitudinal Data Systems Are Fundamental to Using Growth Models

The use of growth models statewide requires that states develop longitudinal data systems to track individual student performance over time. A data system designed to report student growth should incorporate the following essential elements identified by the Data Quality Campaign (DQC):

- *Unique statewide student identifiers* (element 1). This single, nonduplicated number is assigned to a student throughout his or her P–12 career. Year-to-year test scores are linked using a student identifier.
- *Student-level enrollment, demographic and program participation information* (element 2). This information makes disaggregating data on student academic growth by student subgroup possible. If the analyst wants to track growth across multiple years, the information also makes it possible to determine whether the student was enrolled in the same school for those years.
- *The ability to link individual students' test score records over time* (element 3). This ability is necessary to compare prior and current year scores to compute academic growth or value-added.
- *Information on untested students* (element 4). NCLB requires states to keep track of the number and percentage of students who do not take the tests. This information helps identify schools with unusually large absences on test days or schools that fail to test 95 percent of their students. Testing too few students could distort a school's growth statistics as well as its proficiency-level statistics.
- *A statewide audit system assessing data quality, validity and reliability* (element 10).[3] Data should have common definitions, and audits should be conducted in districts to ensure accurate data are being sent to the state. The state assessment should have technical quality, including being both valid and reliable.

Additional capabilities and essential elements that allow growth models to answer more questions about policy and practice include:

- *A teacher identifier system with the ability to match teachers to students* (element 5). This ability allows connections to be made among teacher training, qualifications and student academic growth.
- *Student-level transcript information, including information on courses completed and grades earned* (element 6). This information makes linking students' course-taking choices with academic preparation and growth possible.
- *Student-level college readiness test scores* (element 7). Growth scores can be correlated with student performance on college admissions, placement and readiness tests. Matching student readiness scores with the same students' test scores in middle school makes it possible to analyze the effectiveness of high schools for preparing students.

[3] A. Guidera, *Measuring What Matters: Creating a Longitudinal Data System*, Austin, TX, DQC, 2006, p. 5.

- *Student-level graduation and dropout data* (element 8). States can track what happens to students who drop out, transfer to another school or get a GED. Using the National Governors Association calculation provides a more accurate estimate of high school graduation rates and allows cross-state and district comparisons.[4] Armed with this information, analysts can determine whether the high schools and school systems with the strongest student academic growth also have the fewest dropouts and most graduates among high-risk student populations.

Appropriately designed statewide longitudinal data systems provide educators with the academic history of individual students: their demographic characteristics, courses they have taken, test results, their enrollment history in K–12 and higher education, degrees and certificates awarded, and so on.[5] This information allows educators and policymakers to better understand how well the education system is helping every student achieve high academic standards — and if it is not, where improvements might be made.

Policy and Practice Questions Growth Models Can Help Address

Students

- Are individual students making academic progress over time?
- Are there differences in the academic progress subgroups are making over time?
- Is a student making more progress in one subject area versus another?
- How much growth will a student need to make each year to reach proficiency in, for example, four years?
- Are high-performing students making growth?
- What factors affect student achievement growth?

Programs

- Which schools have faster rates of student growth?
- Which programs work for which students?
- What are the best practices in schools with high growth rates?
- Are all schools making acceptable or trajectory rates of student growth? For different groups of students?
- What course-taking patterns predict student growth?

Policy

- What are the implications of student growth scores for the state role in fostering school improvement? The district role?
- What are the implications of student growth scores for resource allocation and/or assistance to low-performing schools?
- What are the implications of student growth scores for teacher quality?
- What are the implications of student growth scores for incentives and teacher compensation?
- How can growth models be most effectively used as part of calculating AYP?
- What impact will growth models have on students, schools and districts that already have met proficiency?

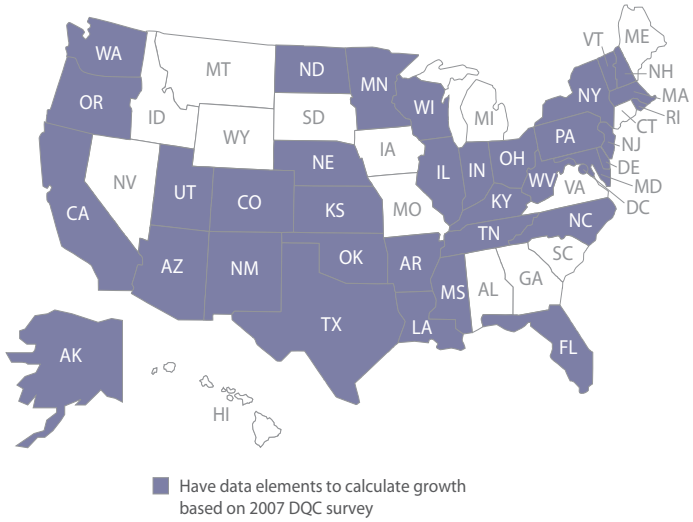
[4] Data Quality Campaign, *Every Student Counted: Using Longitudinal Data Systems To Calculate the National Governors Association's High School Graduation Rate and Improve Student Success*, Austin, TX, July 2007.
[5] A. Guidera, *Measuring What Matters: Creating a Longitudinal Data System*, Austin, TX, DQC, 2006, p. 5.

Status of States' Abilities To Calculate Academic Growth

Based on 2006 DQC survey results, 28 states had the necessary longitudinal data elements to calculate academic growth in the following year.[6] That number rose to 36 plus DC in the 2007 survey.

Cost and technical issues need to be resolved as well. Student identifier systems that make it possible to follow students and calculate growth can cost $1 million to $3 million to develop, depending on the current capability of a state's data system.[7] States have reported building complete longitudinal state data systems for less than $10 million. Maintenance and quality control of the system will require additional resources year after year. Although these numbers sound impressive, they are typically only a small fraction of 1 percent of most states' education budget.

With the exception of value-added models, growth models also require that assessments be scaled comparably enough across years to identify consecutive years' scores that represent roughly a year's typical growth. States also need to set growth standards, identifying how much growth is sufficient for students. The more years of growth data that are available, the better states will be able to set these standards.



[6] Data Quality Campaign, *2006 NCEA State P–12 Data Collection Survey Results*. If a state created a statewide student identifier and linkable student test records in 2006, by 2007 the state would have the minimum of two years' of linked test records needed to calculate academic growth.

[7] N. Smith and J. Armstrong, *Building Longitudinal Data Systems: Lessons Learned from Four Leading States*, Austin, TX, DQC, November 2006, p. 8.

The Use of Growth Models under NCLB

In November 2005, U.S. Secretary of Education Margaret Spellings announced the opportunity for up to 10 states to apply to use a growth model as part of their AYP calculation for ensuring student proficiency by 2014.[8] Growth models would give schools credit toward AYP for student improvement over time by tracking individual student achievement year to year. Two states had their growth models approved for use in the 2005–06 school year, and seven additional states were approved for 2006–07.[9] In December 2007, the U.S. Department of Education lifted the cap so that any state meeting the necessary criteria could have its growth model approved.[10] Two additional states had their models approved for the 2007–08 school year.[11]

States incorporate NCLB growth models into an overall accountability model that can use a combination of AYP calculations including status (snapshot data), growth and safe harbor calculations.[12] States then report AYP results based on the options they choose.

The 11 states whose models have been approved are using various approaches to determining growth. For the purposes of meeting NCLB requirements, they are using three general types of growth models: trajectory, projection and value tables.[13]

Trajectory Models

Trajectory models "identify the gap between each below proficient student's score and proficiency, and establish standards for how much of the gap must be closed each year in order for the student to reach proficiency by the indicated deadline."[14]

Arkansas uses 3rd grade scores as the baseline for measuring growth in successive grades. For each student, Arkansas defines the expected annual achievement gain needed for the student to be proficient by 8th grade. Each student has an individual trajectory based on how far he or she is from the proficiency level in each grade. Students further from proficiency need to make larger annual gains to meet the growth expectation. Growth increments for each grade may vary due to the scaling procedures used for the mathematics and language arts tests. Unlike some other states using trajectory growth models, Arkansas includes students who are proficient or above in its growth model. Students who already are proficient must remain at their current level or improve to be counted in the growth model as making adequate progress.[15]

Florida calculates a three-year (or less) linear growth trajectory based on a student's state assessment score and the score the student will need three years later to be proficient. For each of the three years, the student is expected to close one-third of this achievement gap. For each year a below-proficient student meets this target, he or she is considered to be on track for proficiency and is counted as

[8] U.S. Department of Education, *Growth Models: Flexibility and Accountability*, Nov. 18, 2005, www.ed.gov/admins/lead/account/growthmodel/factsheet.pdf.
[9] The nine states are Alaska, Arizona, Arkansas, Delaware, Florida, Iowa, North Carolina, Ohio and Tennessee.
[10] See www.ed.gov/news/pressreleases/2007/12/12072007.html for the announcement and a list of the conditions that an approved NCLB growth model must meet.
[11] See www.ed.gov/news/pressreleases/2008/06/06102008.html.
[12] With safe harbor, the state, school districts and schools may still make AYP if each subgroup that fails to reach its proficiency performance targets reduces its percentage of students not meeting standards by 10 percent of the previous year's percentage, plus the subgroup meets the attendance rate or graduation rate targets.
[13] C. Dougherty, *Measures of Adequate Growth*, Austin, TX, DQC, May 2007, Vol. 2, Issue 4, p. 2.
[14] Ibid.
[15] Arkansas Department of Education, *Arkansas Growth Model Proposal Submitted to the U.S. Department of Education*, November 2006. Available on the U.S. Department of Education Web site at www.ed.gov/admins/lead/account/growthmodel/ar/argmp.doc.

having achieved adequate yearly growth, a substitute for reaching proficiency in the first two years. The student is expected to reach proficiency in the third year.

Projection Models

Projection models "examine whether the combination of a student's current and prior test scores predict that the student will be proficient at a later date — based on past history of the relationship between prior and subsequent test scores. For example, do a student's third and fourth grade scores predict that the student will be proficient in sixth grade?"[16]

Ohio uses a projection model to augment the traditional AYP calculation. For a given prior test score or set of test scores, the model identifies the lowest current year test score that gives the student at least a 50 percent probability of being proficient in the target grade (often several years later). Data on past groups of students are used to identify the needed score. As with the trajectory model, a school that otherwise would not make AYP with a particular student group can make AYP if the number of students projected to be proficient, added to the number actually proficient in the current year, meets the current year's proficiency target. The principal benefit of this model, as with other growth models, is that it allows Ohio to focus on the schools and districts in which performance is of greatest concern — those in which proficiency rates are low and those in which students are failing to make gains sufficient to achieve proficiency in the next few years.[17]

Value Tables

In value tables, "[s]tudents are divided into achievement level bands (e.g., far below basic, below basic, basic, proficient, and advanced) and points are assigned to students based on their year-to-year movement between bands."[18] Value tables make it easy for school leaders to understand how changes in student performance are translated into changes in school accountability scores.[19]

In *Delaware,* student progress is measured as the change in performance bands or levels for all students in a school or district. The state has adopted a value table assigning points based on a student's prior and current year performance level. For example, students scoring at or above proficiency always receive 300 points, regardless of the growth required to get there. Below-proficient students who progress by one or more levels, but do not reach proficiency, receive from 150 to 250 points, depending on their starting and ending levels. Below-proficient students who do not move up a level receive no points. The state has established the target number of points per student that a school must earn to make AYP; in 2014, this number is 300.[20]

[16] C. Dougherty, *Measures of Adequate Growth,* Austin, TX, DQC, May 2007, Vol. 2, Issue 4, p. 2.
[17] Ohio Department of Education, *Proposal to the United States Department of Education for Employing a Growth Model for No Child Left Behind Accountability Purposes,* 2007. Available on the U.S. Education Web site at www.ed.gov/admins/lead/account/growthmodel/oh/ohgmp07.doc.
[18] C. Dougherty, *Measures of Adequate Growth,* Austin, TX, DQC, May 2007, Vol. 2, Issue 4, p. 2.
[19] R. Hill et al., *Using Value Tables To Explicitly Value Student Growth,* NCIEA, November 2005, www.nciea.org/publications/MARCES_RH07.pdf.
[20] R. Taylor, "Delaware's Growth Model and Results from Year One," 2008, www.ecs.org/html/meetingsEvents/NF2008/resources/GrowthModelpresentation-ECS-070208.ppt.

Elements Needed for Approval of Growth Models

To have their NCLB growth models approved, states should have the following in place:

- *Standards-based student math and English/literacy assessments in grades 3–8 and one high school grade.* These assessments must be aligned to a state's academic content standards for each grade and subject.
- *Vertically scaled or vertically moderated assessments (if a trajectory model is to be used).* Scaling tests provides a metric for year-to-year gains. With vertical scaling, a single scale summarizes the achievement of students across grade levels so that a score of 280 in 3rd grade mathematics represents the same level of achievement as a score of 280 in 4th grade mathematics, meaning that the student has made no progress. With vertical moderation, a 4th grade score of 280 that represents roughly the same position on the 4th grade score distribution as 280 does on the 3rd grade score distribution would mean that the student has achieved roughly a year's growth.[21] In either case, the 3rd and 4th grade scores can be compared and an interpretation made about the change in the student's score across years.[22] Vertical scaling or vertical moderation is not required for a projection growth model.
- *Student proficiency levels/categories on the state assessment.* For every assessment, states must set a score that indicates students have met proficiency. Several levels may be set, such as below basic, proficient and advanced. In the growth model pilots, states often have expanded the number of levels below proficiency (such as far below basic, below basic and basic). This allows for greater precision when analyzing low-performing students' growth toward proficiency, particularly if the state makes an effort to place the categories in roughly similar positions in the score distribution in different grades. Developing a series of appropriately spaced proficiency categories is especially important for a value table growth model.
- *Growth targets and a way to measure growth toward proficiency.* For low-performing students to be considered on track for proficiency, they have to make *accelerated* growth (more than an average year of growth), often for several years. In Iowa's NCLB growth model, a below-proficient student's growth score must place him or her into the next higher proficiency level for the student to receive credit for adequate growth that year.
- *Incorporation of growth into traditional AYP calculations.* The U.S. Department of Education requires growth model pilot states to describe how they will use growth models to calculate AYP. Four options are provided:
  - Growth only;
  - Status and growth;
  - Status, safe harbor and growth; and
  - Safe harbor and growth.

  Most pilot states are using the traditional AYP calculation of status and safe harbor. They also use the growth model calculation as one more way for schools to make AYP and include these schools in their final AYP reporting. This gives credit to schools and subgroups that are making academic progress but are not yet making AYP using the status and safe harbor calculation.

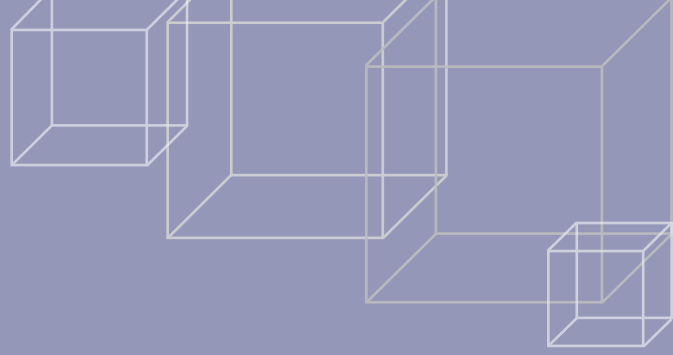
[21] "Regression to the mean" is likely to result in students who are high or low on the statistical distribution in one year making some movement toward the center of the distribution in the following year so that a low-scoring student staying at the same spot in the score distribution has made less than a year's typical growth and a high-scoring student whose place in the distribution doesn't change has made more than a year's typical growth.

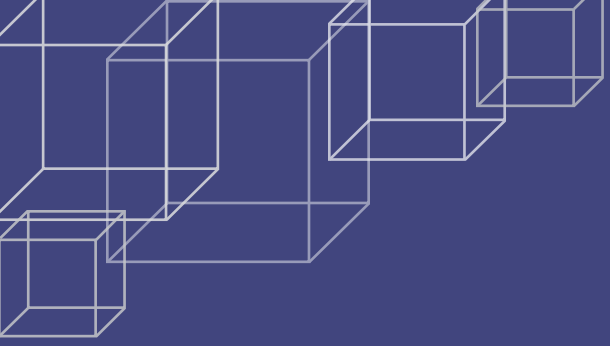
[22] C. Dougherty, *Academic Growth and Scaling Issues,* Austin, TX, DQC, May 2007, Vol. 2, Issue 3.

- *Ways to meet other NCLB provisions.* Growth models are expected to meet all seven core principles outlined by the U.S. Department of Education.[23] Other NCLB requirements include assessing at least 95 percent of all students, ensuring that all groups are part of the state accountability program and using one other indicator such as student attendance or graduation rates in the AYP calculation.

The expansion of growth models will depend on the progress states make toward creating assessment and longitudinal data systems capable of measuring individual students' academic growth over time. Despite the complexity of growth models and the need for a longitudinal data system, the additional information that states, districts and schools can collect and analyze will be invaluable in improving educational policy and practice.

[23] U.S. Department of Education, *Growth Models: Ensuring Grade-Level Proficiency for All Students by 2014*, Washington, DC, July 2007, www.ed.gov/admins/lead/account/growthmodel/proficiency.html.





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