Aligning the Journey With a Destination
A Model for K–16 Reading Standards

A white paper from The Lexile Framework® for Reading

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Table of Contents

Introduction

A great deal has been written in the last few decades about the condition of public education in the United States. Many authors have argued that students are unprepared after high school for the variety of experiences they seek in life, not only those experiences related to higher education but also those related to the military, the workplace and the day-to-day responsibilities of citizenship. (See Williamson, 2006a, for a brief review of some of this literature.)

College readiness and the transition to college have emerged as significant policy issues, as evidenced by reports made to the National Assessment Governing Board (NAGB) by The College Entrance Examination Board (CEEB), American College Testing (ACT), Achieve, Inc., and others (Anagnostopoulos, 2004; Conley, 2004; Gandal, 2004; Kirst, 2003; and Saterfiel, 2004). More attention is turning toward how to achieve a better transition for students between high school and college (e.g., ACT, 2006; Conley, 2006; and Southern Regional Education Board, 2006) and toward attaining an integrated system of education for students across the K–16 continuum (e.g., Achieve, Inc., 2006; Krueger, 2006).

Venezia, Kirst and Antonio (2003) emphasized the difference (and disconnectedness) between the expectations in high schools and the expectations in institutions of higher education. They reported that "…the coursework between high school and college is not connected; students graduate from high school under one set of standards and, three months later, are required to meet a whole new set of standards in college." In their "issue brief" submitted to the Secretary of Education's Commission on the Future of Higher Education, Kirst and Venezia (2006) provided specific recommendations for improving college readiness and success. Among them is the recommendation to "develop clear student achievement targets that will require K–12 and postsecondary systems to achieve them jointly."

Two threads of recent research provide one possible way of developing and aligning (or at least informing the discussion about) student achievement standards for K–16. First, Williamson (2006a) elaborated a continuum of text demand for postsecondary endeavors.

His work demonstrated substantial differences between the materials that high school students are expected to read and the materials they may encounter after high school. The latter reflect a substantially higher text demand, or correspondingly, require a higher reading ability from students in their postsecondary lives.

Secondly, Williamson, Thompson and Baker (2006) described actual growth in reading ability for five successive cohorts of students who were followed longitudinally for six years. Their work provided mathematical characterizations of growth from the end of third grade to the end of eighth grade for each panel of students. By expressing growth as a mathematical equation, it is possible to quantify performance at any time and to determine properties (e.g., rate, acceleration) of the growth over time. Because their data spanned nearly a decade of growth for an entire state, and because that state was widely regarded as one of the most improved states in the United States during that time period, the results provide a good indication of what growth might be expected during the public school years.

A Useful Strategy

These two strands of research provide (1) empirical descriptions of growth in reading ability during the traditional school years and (2) information about the postsecondary reading requirements students face. These two sources of information might be used in concert to effect growth standards that are coordinated across the K–16 timeframe.

Williamson (2006b) suggested that future text demands might provide one useful benchmark for determining growth expectations for reading.

> Given the knowledge that students may encounter more difficult books in their postsecondary endeavors, we can ask how much growth in reading ability must occur during school to allow students to reach the desired reading ability by the end of twelfth grade. This would form the basis for a more demanding growth expectation in reading. (p. 8)

By combining knowledge about the functional form of growth during K–12 with text-based aspirations for future performance, one can construct an empirically based model of an existing growth trajectory in the context of future performance aspirations. Such a model could be a useful roadmap, as it were, to chart a student growth trajectory that leads to desired postsecondary outcomes. Such a characterization would provide both a view of where we want to be, and a way to assure ourselves that students are on the right path to the desired goal at any moment. This short paper illustrates this approach and produces one possible roadmap for K–16 growth in reading ability.

First, let us review results for postsecondary texts and for K–12 growth. A key feature of these two sets of results is the fact that both the readability of the texts and the students' reading ability are measured with the same scale, The Lexile Framework® for Reading. The Lexile® scale is the only known scale that allows both text and reader measures to be made on the same developmental scale. This is critical, because it is what makes it possible to combine both analyses in the same picture for K–16.

Postsecondary Reading Demand

For his analysis of postsecondary text demand, Williamson (2006a) accumulated text difficulty measures for a variety of texts from different postsecondary domains of endeavor. For current purposes, it is useful to briefly review the sources of those materials.

Undergraduate Admissions Tests
These materials included reading passages from 14 of the most recently released versions of the SAT, four forms of the ACT assessment and two Advanced Placement (AP) English exams. The materials were obtained from publications and Web sites maintained by the CEEB and ACT.

Military Materials
Military reading materials were acquired from the U.S. Army website. These included news service articles, selected articles from the Professional Writing Collection, a military history entitled 225 Years of Service, the Soldier's Handbook and a selection of field manuals, training circulars, drills and other documents used for various branches of the armed services. The latter were official departmental publications available from the General Dennis J. Reimer Training and Doctrine Digital Library.

Workplace Materials
Text difficulty measures for workplace materials were provided by the International Center for Leadership in Education (ICLE). They independently analyzed over 1,400 examples of occupational reading materials that spanned the 16 career clusters identified by the U.S. Department of Education.

Community College and University Texts
Questia Media America, Inc., provided text difficulty measures for 100 humanities and social science texts used in courses that most, if not all, freshmen and sophomores have to take. Similarly, they selected 50 titles representing materials that students in community colleges typically encounter.

Citizenship Materials
Citizenship materials included 38 newspapers and wire services; the U.S. District Court's Handbook for Trial Jurors; the Internal Revenue Services' (IRS) 2003 Form 1040 instructions; public online information about state marriage laws, voting rights and responsibilities; and the North Carolina Department of Motor Vehicles' Driver's Handbook. ICLE also provided text difficulties for 11 similar documents, which were included in this category.

The median Lexile measures for the six text collections (from figure 1 in Williamson, 2006a) are summarized in the following table.

Text Collection	Median Lexile Measure
University	1395
Community College	1295
Workplace	1260
Citizenship	1230
Military	1180
Undergraduate Admissions Test	1180

These will be used to represent postsecondary expectations in our K–16 depiction, but first we should review actual growth leading up to that point.

An Average Reading Growth Curve

We will focus on a cohort of 67,908 North Carolina public school students who were third graders in 1999 and who progressed to the eighth grade by 2004. These students remained within North Carolina schools for all six years and had complete histories of reading achievement data. They would have received the full benefit of a consistent, coordinated educational experience because of their geographic stability and the highly aligned curriculum, instruction and assessment programs in North Carolina during this timeframe. Furthermore, North Carolina was among the most improved states in the nation in reading and mathematics achievement during the decade of the 1990s up through the present, based on NAEP scores. Consequently, the average growth curve of these students should provide a good illustration of students' growth toward postsecondary expectations. The data are described in more detail in Williamson, Thompson and Baker (2006a).

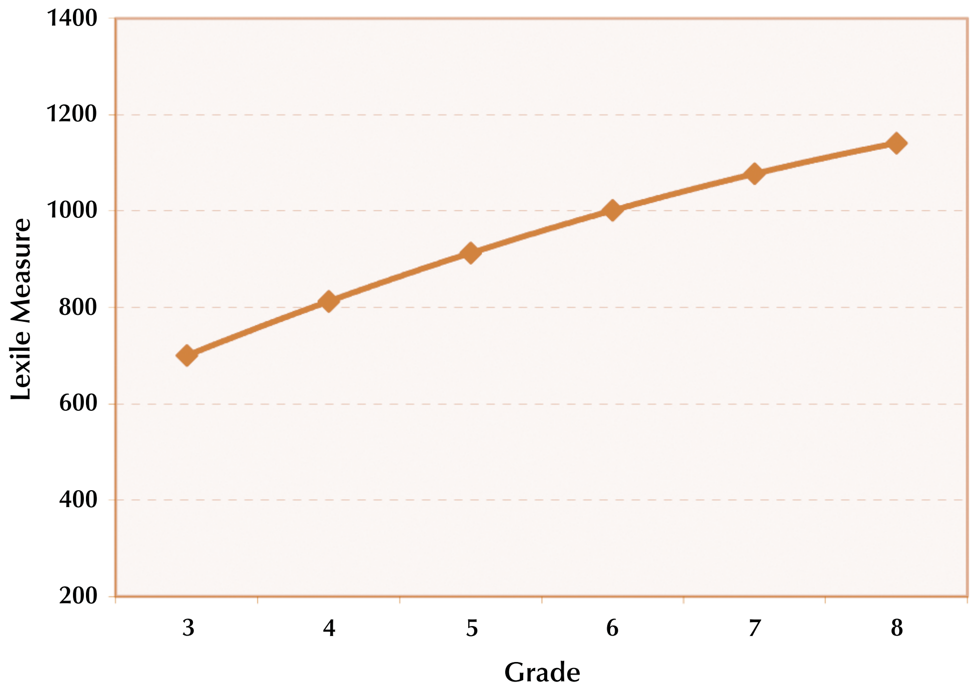
The growth in reading ability of these students from the end of third grade to the end of eighth grade is well described by a quadratic growth curve, depicted in figure 1.

Extrapolated K–12 Growth Curve With Median Postsecondary Text Measures
The curve in figure 1 was estimated with an advanced statistical technique called multilevel modeling. It is based on data collected annually from the end of third grade until the end of eighth grade. Data were not available for earlier or later grades. However, with some caution, the quadratic equation that characterizes the curve through the range of observed data might be used to estimate average performance before third grade and after eighth grade. This can be done simply by evaluating the quadratic at the other time points.

It is important to note that this is a risky procedure, for at least two reasons. First, there are no actual data to check our assumption that growth from grades K–2 and grades 9–12[1] can be described by the same quadratic equation that describes growth from grades

[1]Longitudinal data from Palm Beach County, Fla., do suggest that a quadratic equation may adequately describe growth through tenth grade. Naturally, the average growth curve for Palm Beach County appears to be characterized by different parameter estimates for the quadratic growth function.

Figure 1.
1999—2004 North Carolina Average Growth Curve
(N=67,908)



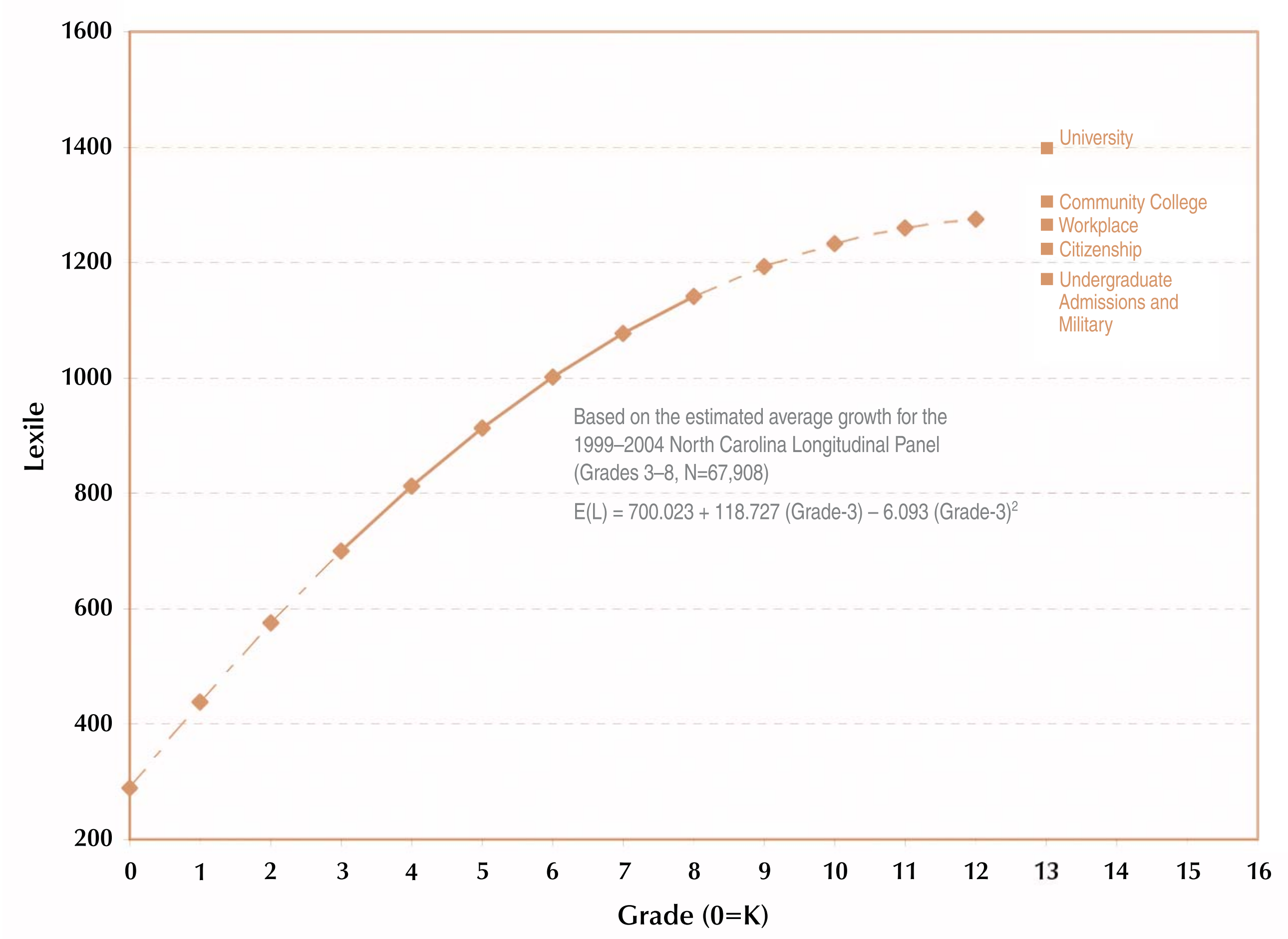
3–8. Second, the nature of a quadratic polynomial is that it has a maximum point or a minimum point, after which the curve reverses direction. When the curve is concave to the time axis (as in figure 1), there will be a maximum point after which the curve turns downward. Since we do not believe that future performance will decline back to the third-grade level and below, this would be inconsistent with our desire to have an accurate description of the developmental nature of growth.

There are two ways to address these concerns. We can analytically check the quadratic equation to determine when the maximum point occurs. If it occurs outside the range of time to which we wish to generalize, then we can worry a little less that our depiction of growth is erroneous. (As it turns out, the maximum for the North Carolina growth curve occurs approximately at grade "13," just beyond the twelfth grade, which is the last grade for which we are projecting achievement.) However, the best way to address the risks of extrapolation is to collect more data so we can fill in the missing time points with student achievement information. Unfortunately, this is harder than it sounds for a variety of reasons, including the costs of collecting the information and the challenge of measuring the same construct over longer and longer periods of time. Consequently, for the time being, we will make use of the data we have and bear in mind that our extrapolations to lower and higher grades may need to be substantially revised based on future information.

With those cautions, let us see what the picture looks like if we combine the information from the text analyses and the information from the growth curve from North Carolina. In figure 2, we see the result.

There are several important things to notice about figure 2. First, the horizontal scale represents grade in school. On this scale, zero stands for kindergarten. Subsequent grades (1–12) are denoted as usual. Then the numbers 13 through 16 are used to denote the next four years of postsecondary education. The vertical scale is denoted in Lexiles, which are used to measure students' reading ability and median text difficulty.

Figure 2.
Extrapolated K–16 Growth Curve With Median Postsecondary Text Measures
(University; Community College; Workplace; Citizenship; Undergraduate Admissions and Military)



In the graph, diamonds are used to indicate the estimated average reading ability of students at each point in time. The estimates for grades 3–8 are connected by solid lines to represent the fact that they are based on the available data. The estimates for grades K–2 and 9–12 are connected with dotted lines to represent the fact that they are theoretical extrapolations determined analytically from the quadratic equation (displayed in the chart) for the observed growth curve. As such, the dotted portions of the curve are only reasonable guesses based on the observed data, subject to future revision based on more complete longitudinal records. The farther one goes from the observed data (grades 3–8), the more one has to bear in mind the provisional nature of the projections. The notation E(L) in the quadratic equation stands for "expected Lexile" and is equated to the actual formula that expresses the expected average score in Lexiles as a function of grade. Finally, in the figure, the median text difficulty of the postsecondary text collections are arrayed vertically at grade 13 to indicate that students face these expectations in the year following their exit from grade 12.

The primary feature of the chart is the alignment of the projected twelfth-grade reader measure in conjunction with the postsecondary text measures[2]. It appears that the average growth trajectory of these

[2] The median difficulty (1130L) of texts used near the end of high school (i.e., grades 11 and 12) is not shown in figure 2, because it does not represent a postsecondary aspiration. High school texts are significantly easier to read on average than are citizenship materials, workplace materials, community college texts or university texts (Williamson, 2006a).

students, if unaltered, will carry them to a reading level that lies somewhere between the median text requirements of the workplace and the community college. Students with higher postsecondary aspirations (e.g., the university) need to be on a higher trajectory that tracks above the average growth curve depicted in figure 2.

Since the growth curve expresses student performance as a function of grade, it lays out a path (also conveying expectations, or potential standards) for academic growth throughout the entire K–12 experience. By adjusting the desired endpoint, one might get a very rough approximation of how to alter intermediate performance expectations to reach a desired end performance. For example, to reach a higher end point, one might imagine a growth trajectory parallel to the average growth trajectory, but at a higher elevation in the figure.

One must remember, however, that individual growth is variable and that students vary in the parameters of their growth. That is, students have different beginning points, different initial velocities and different degrees of deceleration. Each of these features of quadratic growth results in a slightly different trajectory compared to the average growth trajectory. Thus, there are many possible ways to reach a given end point, not all conveyed by simply changing the elevation of the average growth curve. For example, one student might begin at a higher level and exhibit modest but steady growth with little deceleration over time. Another might start out lower in reading ability but progress very rapidly with more deceleration over time. Both students might reach the same twelfth-grade reading ability through different individual growth curves.

Summary

This paper presents one strategy for determining and aligning reading growth standards so they are consistent with postsecondary performance expectations embodied in text materials that students may encounter in various postsecondary endeavors. The strategy takes advantage of the availability of measures of text difficulty for postsecondary text collections and recent growth results for a large number of students whose longitudinal data span grades 3–8. The primary advantages of the approach are:

- It uses a common metric for text readability (difficulty) and reading ability
- It uses longitudinal data to determine the characteristics of typical student growth during the public school years.
- It uses texts from the most commonly considered postsecondary student endeavors.
- It is easily revised when new information about growth or postsecondary texts becomes available.

This approach produces information that is potentially useful to educational leaders and policy makers who face the challenge of creating better alignment between the K–12 schools and postsecondary institutions of higher education in the United States. It provides a new model for reporting educational growth and performance, taking the aspirations of students and various educational stakeholders into account. It could also help teachers, students and parents by providing a text-based, aspirational context for evaluating the reading growth trajectories of students over time.

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About the Author

Gary L. Williamson, Ph.D., is a senior research associate at MetaMetrics, Inc. With more than 30 years of experience in educational research on the academic, state and school district levels, Williamson's specialty is quantitative methodology encompassing psychometric, mathematical and statistical applications to educational data. He has written and spoken extensively on the subjects of educational assessment and accountability. Williamson earned both a doctorate of philosophy in mathematical methods for educational research and a master's of science in statistics from Stanford University. He also holds a master's of education in educational research and evaluation from The University of North Carolina at Greensboro, and a bachelor's of science in mathematics from The University of North Carolina at Chapel Hill.

About The Lexile Framework for Reading

MetaMetrics®, Inc. developed The Lexile Framework® for Reading and its companion scale, The Quantile Framework® for Mathematics. The Lexile Framework (www.Lexile.com) provides a common scale for matching reader ability and text difficulty, enabling teachers and parents to choose materials that can help to improve student reading skills and monitor literacy across the curriculum and at home. Recognized as the most widely adopted reading measure in use today, Lexiles® are part of reading and testing programs at the district, state and federal levels. More than 100,000 books, 80 million articles and 60,000 Web sites have Lexile measures, and all major standardized tests can report student reading scores in Lexiles. Launched in 2004, Quantiles® (www.Quantiles.com) measure student mathematics achievement and concept/application solvability similar to the way Lexiles measure reading proficiency. The Quantile Framework represents a student's ability to think mathematically in a taxonomy of mathematical skills, concepts and applications. The Quantile strands—Geometry; Measurement; Numbers and Operations; Algebra/Patterns & Functions; and Data Analysis & Probability—integrate and align with the strands described by the National Council of Teachers of Mathematics (NCTM).

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