

Technical Paper

**Achieve3000:
Forecasting Student
Performance**



ACHIEVE3000®

The Leader in Differentiated Instruction

Achieve3000: Forecasting Student Performance

Introduction	2
Development of the Forecasting Report	3
Using the Forecasting Report	5
Common Questions and Answers	6
Appendix A	8
Appendix B	9

■ Introduction

Educators often ask the question, “How will this student likely do on the state assessment at the end of the school year?” They ask the question for many reasons including the need to inform instruction that will occur between now and the end of the school year and also to determine who needs intervention and who needs enrichment.

Achieve3000®, in partnership with MetaMetrics®, has developed a Forecasting Report available to educators in certain states as part of Achieve3000’s literacy intervention solutions, KidBiz3000™, TeenBiz3000®, Empower3000™, and Spark3000®. The purpose of this white paper is to provide detailed information concerning the development and uses of the Forecasting Report and to answer some commonly asked questions.

Development of the Forecasting Report

When educators ask the question “How will this student likely do on the state assessment at the end of the school year?,” what they are really asking is “Can we predict how this student will do based on what we already know about the student?” Just as meteorologists forecast the weather, educators want to forecast how a student is likely to perform in the future.

There are two basic ideas underlying forecasting: first, that the experiences of the past can be used to predict the future; and second, that any such predictions include some level of uncertainty that increases based on how far in the future the predicted event will occur.

Forecasting the Weather

A well-known type of forecasting is predicting where a hurricane will make landfall. A typical “tracking” map will depict the path that the hurricane has taken to its current position. A cone emanates from that position that grows wider and wider as the hurricane’s future positions are predicted, typically in twelve-hour increments.

The “experiences of the past” in this case include a variety of measurements such as wind speeds and directions. These measurements are combined with models that have been developed from prior hurricanes that relate these measurements to a hurricane’s movements. *Figure 1* shows the projected path of a hurricane over a 60-hour period. The central part of the cone reflects the consensus of the model as to the hurricane’s most likely position over the course of these 60 hours. The increasing width of the cone reflects the uncertainty surrounding these likely positions. This uncertainty comes from multiple courses including the extremely complex nature of hurricanes and what influences their movement as well as a lack of sufficient data due to data gathering limitations and a possible lack of awareness about what data is needed.



Figure 1 – Sample hurricane “tracking” map showing current position and predicted path. Retrieved from The Weather Channel (www.weather.com).

Forecasting Student Performance

The same issues that challenge the prediction of hurricane movement are also in effect when it comes to predicting a student’s future performance on a test. In *Figure 2*, the X’s indicate a student’s performance on an interim assessment instrument administered in October, December, and January. The solid line running between the X’s captures the approximate student’s growth through January with the slope of the line representing the rate of growth.

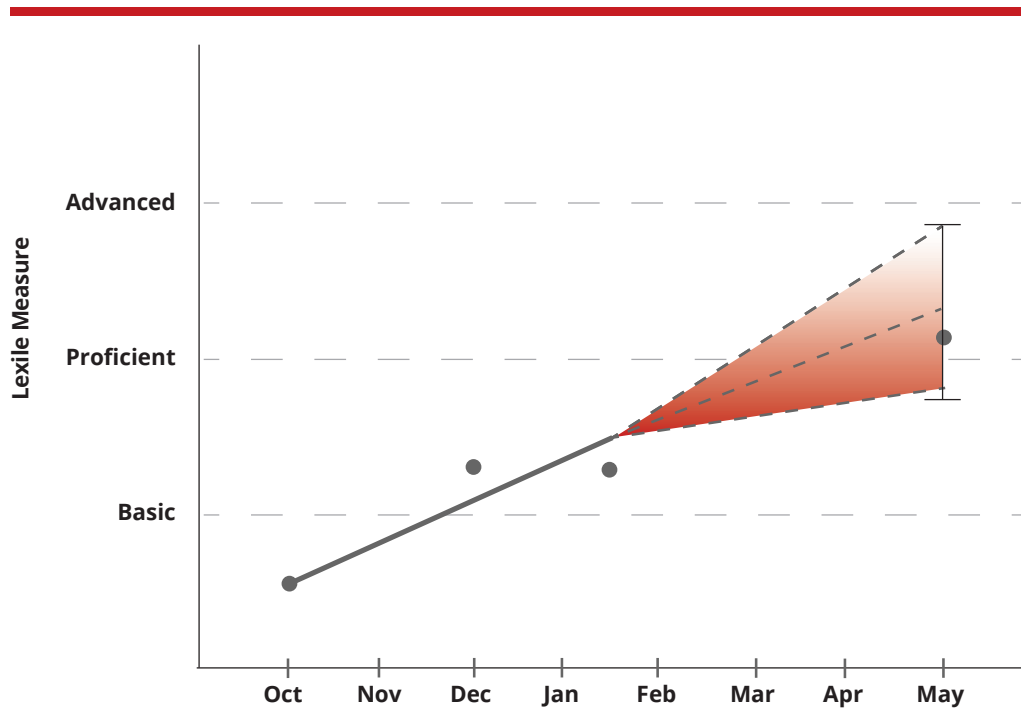


Figure 2 – Sample student “tracking” map showing current test results and predicted test result.

This growth rate line can be extended out to when the student will be taking an end-of-year test in May that will determine whether the student is promoted or retained (the dotted portion of the growth line). The promotion decision rests on whether the student achieves a score that falls above the “Proficient” performance standard. Other standards that the state may have established, in this example “Basic” and “Advanced”, are also represented on the graph. The prediction is that if this student maintains his current growth rate, he will score above the “Proficient” level and be promoted. However, since the end-of-year test will not be taken for over three months, there is a wide range of uncertainty about what his actual score may be at that time. Factors causing this uncertainty include the reliability and validity of the test score as a measure of student ability, the impact of the curriculum and the effectiveness of the instruction, and factors such as whether or not the student is feeling well when the test is administered. In this example, the student’s actual score on the end-of-year test is below the prediction, but still sufficient for him to be promoted.

Forecasting Process

The following steps are followed to forecast how a student will likely do on an end-of-year assessment based on current and past performance:

1. Obtain the student's first Lexile measure, either based on a Lexile assessment or other prior achievement score reported as a Lexile measure.
2. Update the estimates of ability and uncertainty of the student's test score.
 - The amount the student is expected to grow (in Lexiles) in this time period is added to the student's current Lexile measure.
 - The amount of uncertainty in scores (in Lexiles) from the end-of-year assessment is calculated based on information about the assessment (e.g., standard error of measurement, test-retest reliability) and is then combined with the uncertainty associated with the score.
3. Calculate the probability of the student's likely score in each performance standard on the end-of-year assessment. Because the end-of-year assessments have been linked with *The Lexile Framework for Reading*, the performance standards can also be described using the Lexile metric. See Appendix B for more information.

■ Using the Forecasting Report

The Forecasting Report can assist you in identifying those students most in need of reading intervention. It is used to identify students who are at risk of performing below proficiency on your state test. This performance forecast—based on your students' Lexile scores—provides valuable instructional planning information for teachers and administrators.

The report is available immediately after students take the LevelSet assessment and is available throughout the year until the state test is administered. The report is updated each time students take the LevelSet assessment and/or when a student's Lexile is adjusted automatically through the literacy solution based on student performance or manually by an educator based on observation.

The report is available to school and district administrators in their monthly Achieve3000 Performance Report and can be printed from the KidBiz3000, TeenBiz3000, Empower3000, and/or Spark3000 Teacher's Edition using the *Admin* section. The report is found under Performance Reports and is titled "*How are my students likely to perform on the (state) assessment?*" Please note the Forecasting Report is only available in states and grades where MetaMetrics has linked the state assessment to the Lexile Framework for Reading. Please refer to the following list: www.lexile.com/about-lexile/How-to-get-lexile-measures

Research shows that giving predictive information to teachers about state test performance allows them to be more targeted in their instruction of students. This translates to better student performance on high-stakes tests. Researchers describe three key aspects of differentiated instruction:

- Understand content progression (i.e., by knowing the Lexile measures of resources)
- Determine student readiness (i.e., by knowing each student's Lexile measure)
- Differentiate instruction by linking students with appropriate instruction at their levels (i.e., by knowing the Lexile measure of the instruction and matching it with the Lexile measure of the student)

Assessment is critical to teaching, and the relationship between assessment and instruction must be integrated and reciprocal. By understanding where students need to be, teachers can identify appropriate materials and maximize student growth.

If the report indicates that many students are likely to perform below standard on your high-stakes test, Achieve3000 Solutions include tools and implementation strategies that can be implemented to increase performance. We encourage you to plan aggressive intervention to move students ahead before the high-stakes tests are administered. You can still make a difference!

Once you have identified students who are at risk of performing below proficiency on the state tests, consider some of the following action steps:

- **Increase usage.** Students who use Achieve3000 Solutions twice weekly make Lexile gains three times greater than expected. Accelerate students' Lexile gains by having them complete at least two multiple-choice activities weekly.
- **Be mindful of scores.** Research has found that the quality of the work that students complete on Achieve3000 Solutions is a statistically significant predictor of their performance gains. Maximize student results by challenging them to do their best. For best results, aim for activity scores above 75%.
- **Encourage teachers to become active participants in the Five-Step Literacy Routine.**
- **Encourage teachers to use point-of-use resources** to reinforce key concepts and words and to integrate proven-effective reading comprehension strategies into lessons.

■ Common Questions and Answers

Q *How does this tool work? How does Achieve3000 know how our students will perform on the end-of-year state tests?*

A MetaMetrics has conducted extensive research to link Lexile reading measures with state test performance. For example, in Illinois a sample of students in each grade was administered the Stanford Achievement Test Series, Tenth Edition (Stanford-10) published by Pearson Assessments along with a Lexile Linking Test. The two score scales—the SAT-10 reading comprehension scale and the Lexile scale—were linked to one another (using a mean-anchored scale-to-scale linking method). The information from these linking studies—conducted for states across the nation—can be used to draw conclusions about students' performance on high-stakes tests.

Achieve3000's forecasting tool leverages the extensive research conducted by MetaMetrics. Our application analyzes the student's current Lexile measure, the amount of time until the state test will be administered, and previous research regarding typical growth in reading. This information, combined with the research that links state tests to Lexiles, is used to determine how the student will likely perform on the state test.

Q *The report says "There is no data available." Why is it not showing any data?*

A If your state does not test the grade for which you are running the report, the report will not show any data. Another reason the report might not show data is that your state test date has already passed.

Q *Why isn't this report offered for my students?*

A The Forecasting Report is only available in states and grades where the state assessment has been linked by MetaMetrics to the Lexile Framework for Reading. Please refer to the following list: www.lexile.com/about-lexile/How-to-get-lexile-measures

Q *My students' LevelSet scores seem very low, and I'm concerned they are not accurate. Will this affect the validity of the forecasts?*

A It could. The forecasted readiness data are based on your students' LevelSet scores, so the accuracy of these scores is critical. The system will identify you if students complete the LevelSet assessment using potentially invalid responding. Additionally, if you have reason to believe that some of your students' LevelSet scores are inaccurate (for example, they don't match what you know about your students' reading abilities), you can re-administer invalid LevelSet assessments or manually adjust your students' Lexile levels within three weeks of test administration. Changing a LevelSet Lexile measure or re-administering a test should only be done when the administration of the test is deemed invalid. For more detailed instructions, click Get Help, under Training and Support in the upper right-hand corner of the Teacher's Edition. Refer to the section titled "LevelSet Assessment." Additional resources may be found in the Learning Center, also found by clicking on Get Help under Training and Support.

Q *What happens when students take LevelSet again? Are the forecasts updated?*

A Yes. The report is updated each time students take LevelSet or have their Lexiles updated, as long as the state test date has not yet passed. The forecasts are likely to change as students' Lexile measures increase and as the end-of-year state test draws closer. For example, a particular student may have initially scored below grade level on LevelSet, and the system might have forecasted that he would perform below standard on the high-stakes tests. However, if his Lexile reading level increased over the course of the school year, the report will reflect a NEW forecast based on his new, increased abilities.

Q *Is forecasting information included in other Achieve3000 reports?*

A Yes. The Achieve3000 Performance Report (APR) includes a data section called 'Forecast for performance on the state assessment'. This data section is included on the report each month leading up to the month the assessment is scheduled for and provides the percent of students, by grade or grade band, forecasted to align to each proficiency category. APR is a monthly report that is distributed to school and district administrators, as well as some data, training and purchasing contacts. Please contact Customer Support by visiting www.achieve3000.com/support if you are unsure of the contact that receives the APR for your account. Please note the Forecasting Report is only available in states and grades where MetaMetrics has linked the state assessment to the Lexile Framework for Reading. Please refer to the following list: www.lexile.com/about-lexile/How-to-get-lexile-measures Additionally, Achieve3000 offers forecasting information in the report 'How likely are my students to be College and Career ready when [my state assessment] is administered.' This report shows both current and projected College and Career readiness information for each student. Teachers can use this report to see how students are progressing toward Common Core Lexile performance expectations as their state assessment nears, and in turn use this information to make instructional decisions.

■ Appendix A

How Does Forecasting Work?

MetaMetrics has developed a methodology for forecasting performance that combines growth modeling with Bayesian methodology. Bayesian methodology is a statistical approach for controlling the level of uncertainty in predicting a student's test score by incorporating the student's prior test scores into an adjustment to the current score. The result is that the adjusted score is a more accurate measure of the student's true ability level.

Bayesian Methodology. Both prior information and forecasted results on end-of-year assessments are represented via probability models reflecting uncertainty (Iversen, 1984). The uncertainty associated with prior scores is modeled by a probability distribution for the student's ability. This distribution is called the *prior or posterior distribution* and it is usually represented by a probability density function, i.e., the normal bell-shaped curve that is centered on an estimate of the student's ability level based on prior scores. When no prior assessments are available for a student, the prior distribution can be imputed from the student's grade and/or age.

For end-of-year assessments that have been linked with *The Lexile Framework® for Reading*, uncertainty can be estimated more precisely because information is known about how Lexile® measures relate to the end-of-year assessment results. Please see the list of assessments that have been linked with the Lexile scale on the Lexile website (www.lexile.com/about-lexile/How-to-get-lexile-measures). It should be noted that the amount of uncertainty associated with a student's ability estimate is also affected by the extent to which that student's ability matches the difficulty of the test that he or she has taken or will take. If the test is very difficult or very easy, then the amount of uncertainty associated with the resulting ability estimates will be high and this, in turn, will affect the level of uncertainty associated with the forecasted performance.

Once an ability estimate has been obtained from one or more administrations of a test, that estimate and its uncertainty can then serve as basis for the prior distribution which can be applied to predicting achievement on another assessment occurring within a short period of time. However, since it is likely that a substantial amount of time will have passed before the end-of-year assessment, an allowance must be made for an uncertain amount of growth in ability that will occur between when the most recent test was administered and when the end-of-year assessment will be administered. This allowance is accomplished by means of a growth model that estimates both the growth in ability and the increase in uncertainty as a function of the elapsed time between the assessments.

Growth Modeling. MetaMetrics has developed a growth-rate model based on an analysis of a longitudinal dataset that examined growth in reading and mathematics across grades 1 through 12 for approximately 100,000 students. The purpose of the study was to describe the functional form of growth across the grades during the school year. It was found that younger students grow at a faster rate than older, experienced students. Modeling the growth rate as a decreasing function of current ability incorporated this difference. The resulting values in the equation were based on a regression analysis of the longitudinal

dataset to determine the intercept (estimated average growth per year) and slope (change in growth per unit-change in ability) when growth is regressed on ability. It was also found that by limiting the forecast to the school year, growth during this brief period could be treated as linear in that students make about the same amount of growth each month. Consequently, the forecasting model can be applied to student test data regardless of the testing dates as long as those dates all fall within a school year. The accuracy of the forecast improves as the student takes more assessments, both because of the availability of more prior data to estimate the student's ability level and because of the shorter time that will elapse between the administration of the most recent test and the administration of the end-of-year assessment.

■ Appendix B

Describing Performance Standards in Lexiles By Linking State Assessments Linked with the Lexile Scale.

MetaMetrics partners with departments of education to conduct a study that links (or equates) the underlying reading scale of their state test with the Lexile scale. These "linking" studies enable students' reading scores to also be reported as Lexile measures.

MetaMetrics conducts an analysis of the state reading test in order to construct a "theoretically parallel" (t-parallel) linking test for each grade included in the study. For tests without a vertical scale, every grade is included in the study. For tests with a vertical scale, every other grade is sampled. In both cases, about 2,000 students per grade sampled are required for the linking study. Students are recruited by the state and/or districts. A true random sample is not necessary, although a range of abilities is recommended. Students included in the sample complete the t-parallel linking test within a few weeks of taking the state assessment. Typically, the linking test takes no more time to complete than the state assessment, although it is not a timed test. MetaMetrics examines the relationship between the linking test and the state reading test using one of several statistical procedures (e.g., linear equating, equipercentile equating, item calibration).

Upon completion of the linking study, MetaMetrics provides the state Department of Education with a technical report that details the study procedures and results. The report, which is the property of the education department, includes the conversion tables to translate each scale score from the state test at each grade level into a corresponding Lexile measure. Upon review and approval of the technical report, the education department can begin reporting Lexile measures from its assessment.

References

Iversen, G.R. (1984). Bayesian statistical inference. Sage University Paper series on Quantitative Applications in Social Sciences, series no. 07-001. Beverly Hills: Sage.



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