Washington State
Institute for
Public Policy

110 Fifth Avenue Southeast, Suite 214 • PO Box 40999 • Olympia, WA 98504-0999 • (360) 586-2677 • www.wsipp.wa.gov

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TENTH-GRADE WASL IN SPRING 2006: RELATIVE STRENGTH OF ASSOCIATIONS BETWEEN STUDENT CHARACTERISTICS AND MET-STANDARD RATES

The 2006 Legislature directed the Washington State Institute for Public Policy (Institute) to conduct a "review and statistical analysis of Washington assessment of student learning [WASL] data."[1]

This report describes the *relative* strength of associations between various student characteristics and "met-standard" rates on the 10th-grade WASL in spring 2006.

A forthcoming report will consider how student characteristics are *individually* associated with 10th-grade WASL results in spring 2006.[2]

While previous reports have considered the relationship between student characteristics and WASL performance in isolation, the results presented here are based on multivariate statistical analyses. This approach estimates the relative strength of associations between different student characteristics and WASL performance, and can also be used to identify characteristics that are interrelated with one another.

We begin with a brief discussion of our analytical approach. We then consider the overall explanatory power of our analyses. We conclude that the student characteristics in our analysis are quite successful at distinguishing students who did and did not meet standard in reading and writing, but that the same characteristics are somewhat less strongly associated with math performance (although the explanatory power remains moderately strong). Finally, we consider the relative strength of the associations between student characteristics, both demographic and performance-oriented, and WASL results.

SUMMARY

This report analyzes the relative strength of associations between various student characteristics and "met-standard" rates on the 10th-grade WASL in spring 2006.

Four student **demographic characteristics** are strongly associated with met-standard rates in reading and writing, and moderately associated with met-standard rates in math:

- Enrollment in special education,
- Parents' educational attainment,
- Poverty, and
- Non-English language speakers.

Relative to these characteristics, the associations of gender and race/ethnicity with WASL met-standard rates are much weaker.

In addition to demographic characteristics, two **"performance-oriented characteristics"** are also strongly associated with WASL performance:

- Students' educational aspirations, and
- Time spent on homework.

Two additional performance-oriented characteristics—time spent watching TV and enrollment in vocational education programs—are weakly associated with WASL performance.

These performance-oriented characteristics are associated with and partially mediate the impact of parents' educational attainment. They are also related to a student's prior academic performance, making it difficult to establish the direction of causality.

[1] SSB 6618, Chapter 352, Laws of 2006.

[2] R. Barnoski & W. Cole. (2007). *Tenth-grade WASL in spring 2006: How individual student characteristics are associated with performance*. Olympia: Washington State Institute for Public Policy, Document No. 07-02-2201.

ANALYTICAL DESIGN

We use a statistical technique called logistic regression to analyze the relative strength of associations between student characteristics and WASL met-standard rates. Two separate analyses are conducted.

The first analysis includes only the following demographic characteristics: gender, race/ethnicity, poverty, language, special education status, and parents' educational attainment. The Office of Superintendent of Public Instruction (OSPI) provided the Institute with these data.

The second analysis adds four "performance-oriented" indicators: enrollment in vocational education, educational aspirations, time spent on homework, and time spent watching TV. These characteristics are added separately because a student's aspirations, study habits, and enrollment in vocational programs are partly a function of his or her prior academic performance. For example, a student may adjust his or her educational aspirations based on prior achievement in classes or on tests.

Thus, performance-oriented characteristics pose a "chicken-and-egg" dilemma for statistical analyses, which makes it difficult to establish causal priority: do educational aspirations impact academic achievement, or does prior achievement shape a student's aspirations? Although we cannot establish the direction of causality with these data, adding performance-oriented indicators shows how they modify the associations between demographic characteristics and performance on the WASL.

EXPLANATORY POWER OF THE ANALYSES

Exhibit 1 shows how well the demographic and performance-oriented characteristics in our analysis account for meeting standard in reading, writing, and math.

A statistic called the Area Under the Receiver Operating Characteristic Curve (AUC) is the most appropriate measure for gauging the strength of associations between student characteristics and WASL performance. The AUC, which varies between 0.500 (no explanatory power) and 1.00 (full explanatory power), assesses how well the combination of student characteristics in our analysis distinguishes between students who did and did not meet standard.[3]

Exhibit 1
Explanatory Power of Student Characteristics

Subject Area	AUCs*	
	Demographics	Demographics and Performance
Reading	0.800	0.828
Writing	0.798	0.822
Math	0.736	0.776

* Area Under the Receiver Operating Characteristic Curve statistic.

The AUCs for reading and writing vary between 0.798 and 0.828, whereas the AUCs for math are smaller (0.736 and 0.776). These findings suggest that the student characteristics in our analysis are somewhat more successful at distinguishing students who did and did not meet standard in reading and writing than in distinguishing performance in math. We conclude that additional explanatory characteristics that are uniquely associated with performance in math may not be included in the databases we analyzed.

Because meeting standard in all three subject areas is driven primarily by performance in math, the results for math also approximate the association between student characteristics and overall met-standard rates.

[3] M.E. Rice & G.T. Harris. (2005). Comparing effect sizes in follow-up studies: ROC Area, Cohen's *d*, and *r*. *Law and Human Behavior* 29(5): 615-620; J.A. Swets. (1988). Measuring the accuracy of diagnostic systems. *Science* 240: 1285-1293.

- **Gender** is represented by an indicator for male students, and results are interpreted relative to female students.
- **Race/ethnicity** is represented by four minority indicators—African American, Hispanic, American Indian, and Asian—that are interpreted relative to White students.
- **Poverty** describes students who are eligible for free or reduced-price meal benefits, or who receive Title I services from the Targeted Assistance or Migrant Education programs.
- **Non-English language index** is a sum of four data elements: students (1) whose primary language is not English, (2) who speak a non-Asian foreign language, (3) with English Language Learner status, and (4) for whom a language other than English is spoken at home.
- **Special education** indicates whether a student receives special education services.
- **Parents' education**, self-reported by students on the 9th-grade Iowa Test of Education Development (ITED) survey, is a proxy for students' socio-economic status. This characteristic ranges from neither parent finished high school to at least one parent completed post-graduate school.
- **Vocational education** indicates whether the student participated in a career and technical education or technical preparation course.
- **Hours doing homework** ranges from 0 to 10 or more hours per week, and **hours watching TV** ranges from less than 1 hour to 5 or more hours per week. Both measures are self-reported by students on the 9th-grade ITED survey.
- **Educational aspirations**, self-reported on the 9th-grade ITED survey, range between not expecting to complete high school and expecting to complete post-graduate school.

Exhibit 2
Relative Association* Between Student Characteristics and Met-Standard Rates on the 10th-Grade WASL in Spring 2006

	Reading		Writing		Math	
	Demographics	Demographics and Performance	Demographics	Demographics and Performance	Demographics	Demographics and Performance
Demographic Characteristics						
Male	-9	-4	-25	-21	+7	+13
African American	-9	-10	-7	-8	-13	-15
Hispanic	-4	-4	-3	-4	-9	-11
American Indian	-6	-6	-5	-5	-5	-5
Asian	+2	-1	+6	+3	+5	+2
Poverty	-18	-17	-17	-16	-16	-16
Non-English language	-22	-21	-21	-21	-7	-5
Special education	-31	-30	-29	-27	-27	-25
Parents' education	+23	+12	+21	+10	+26	+13
Performance Characteristics						
Vocational education		-4		-3		-4
Hours doing homework		+15		+13		+15
Hours watching TV		-2		-4		-6
Educational aspirations		+25		+24		+27

* Standardized logistic regression parameter estimates (times 100).

RELATIVE ASSOCIATION BETWEEN STUDENT CHARACTERISTICS AND WASL PERFORMANCE

This analysis estimates the relative association between student characteristics, both demographic and performance-oriented, and WASL performance.[4]

The standardized logistic regression parameter estimates reported in **Exhibit 2** describe the net association between each student characteristic and met-standard rates in reading, writing, and math. Because the estimates are standardized, they may be compared directly: *the larger the absolute value of a parameter, whether positive or negative, the stronger its association with met-standard rates*. Positive values indicate that the characteristic is associated with increased met-standard rates, whereas negative values indicate a decreased likelihood of meeting standard.

Results for reading: Receipt of special education services has the strongest association with met-standard rates for reading (-31), even when other student characteristics are taken into account. Parents' education (+23) and the non-English language index (-22) are the next two most influential characteristics. Parents' educational attainment is associated with increased performance in reading; conversely, students for whom English is not their primary language have lower met-standard rates in reading. Compared with these characteristics, the relative associations of race/ethnicity and gender with met-standard rates are considerably weaker.

Adding performance-oriented characteristics to the analysis did not significantly alter the estimated associations of race/ethnicity, poverty, and language with WASL performance. This result means that the performance-oriented measures in Exhibit 2 influence WASL met-standard rates independently of race/ethnicity, poverty, and language.

However, the strength of the association between parents' education and met-standard rates in reading declines by nearly half, from +23 to +12, when student performance indicators are included in the analysis. This happens because the school performance characteristics are also associated with parents' level of education. Consequently, when school performance indicators are added to the analysis, parents' education becomes less influential relative to educational aspirations and time spent on homework.

Results for writing: The results for reading are similar to those for writing, with one exception: the likelihood of meeting standard in writing was substantially lower for male students relative to female students, holding other characteristics constant.

Results for math: Results for math differ from those for reading and writing in several respects. Special education status, parents' education, and poverty remain the most influential characteristics. However, in contrast to the results for reading and writing, the met-standard rate in math is higher for male students than for female students (other characteristics being equal). In addition, the association between our non-English language index and WASL performance is much weaker for math, while the association between African American and performance on the math assessment is somewhat stronger.

[4] A forthcoming report will describe each characteristic in more detail. R. Barnoski & W. Cole. (2007). Document No. 07-02-2201.

For further information, contact
Robert Barnoski at (360) 586-2744 or barney@wsipp.wa.gov
or Wade Cole at (360) 586-2791 or wcole@wsipp.wa.gov

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Washington State Institute for Public Policy

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