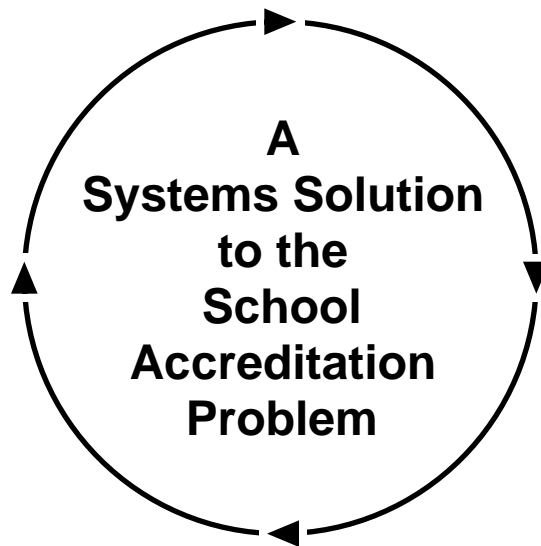


THE THOMAS JEFFERSON
INSTITUTE FOR PUBLIC POLICY



Th Jefferson

Value-Added Accountability



David Wheat
Business and Education Consultant

Second Edition
February 2000

Thomas Jefferson Institute for Public Policy

The Thomas Jefferson Institute for Public Policy is a non-partisan research and education organization devoted to improving the lives of the people in Virginia. The Institute was organized in 1996, and was the only state and local government focused public policy foundation in Virginia based on a philosophy of limited government, free enterprise and individual responsibility. It is a "solutions tank" seeking better ways to accomplish the policies and programs currently being undertaken by state and local government – always based on the Institute's underlying philosophy. The first study was published in February 1997.

The work of the Thomas Jefferson Institute for Public Policy is geared toward educating our political, business and community leadership about the issues facing our society here in Virginia. The Institute offers suggested solutions to these problems in a non-partisan manner.

The Thomas Jefferson Institute is a fully approved foundation by the Internal Revenue Service. It is designated a 501(c)3 organization and contributions are tax-deductible under the law. Individuals, corporations, associations and foundations are invited to contribute to the Thomas Jefferson Institute and participate in our programs.

For more information on the programs and publications of the Thomas Jefferson Institute, please contact:

Thomas Jefferson Institute for Public Policy
9035 Golden Sunset Lane
Springfield, Virginia 22153
703/440-9447
email: mikethompson@erols.com

This study, *Value-Added Accountability: A Systems Solution to the School Accreditation Problem*, is published by the Thomas Jefferson Institute for Public Policy. This study does not necessarily reflect the views of the Thomas Jefferson Institute or its Board of Directors. Nothing in this study should be construed as an attempt to hinder or aid any legislation.

Foreword to the Second Edition

The Thomas Jefferson Institute is proud to release this second edition of David Wheat's report, *Value-Added Accountability: A Systems Solution to the School Accreditation Problem*, in which he elaborates on his earlier recommendations. Many who read or heard about the first edition seemed to think that the author was criticizing the Standards of Learning. On the contrary, he was recommending a more realistic way of tying public school accreditation to significant improvement in the SOLs without losing public support for this reform effort. Indeed, the author is a strong advocate of retaining students who do not pass the SOLs in grades, 3, 5, and 8. He also agrees that students need to pass their end-of-course SOL tests in order to graduate from high school. In the process of expanding the recommendation section (beginning on page 19), the author also discovered and corrected some factual and interpretive errors in the report that had no effect on the findings, conclusions, or policy recommendations contained in the first edition.

This is the third major study on public education published by the Thomas Jefferson Institute for Public Policy and written by David Wheat, a respected business and education consultant who taught for more than a decade in Virginia's public schools, helped draft the Commonwealth's history and government Standards of Learning, and now teaches at the college level.

Although Virginia's learning standards are considered among the best in the country, there is a growing chorus in our state among those who want to water down the SOLs. Unfortunately, such opposition to the learning standards is bolstered by increasing evidence of serious flaws in the related set of standards for school accreditation. Various advocacy groups would like to use the problems caused by the *accreditation* standard (that requires each school to have 70% of its students passing all SOL tests by 2007) as an excuse to "dumb down" Virginia's critically important *learning* standards.

Wheat's study does document the problems with the Standards of Accreditation (SOA), and he concludes that the "70 percent accreditation goal" is not a realistic target for most of Virginia's schools. However, the study makes it clear that the problem is due to the design of the SOA standard itself rather than a result of the rigorous content of the SOLs.

The author is a strong advocate for the SOLs, having been a major participant in their development five years ago. He concludes that the accreditation goal is undermining rather than supporting the SOLs and will lead to a political backlash against both the learning standards and the accreditation standards unless the latter is fundamentally redesigned. He recommends a new accreditation standard that challenges schools to be accountable for teaching the SOLs, but puts the focus on improving each class of students that moves through a particular school system. The logic is compelling.

This study is presented in an effort to bring fresh and creative ideas to the public arena for discussion and debate. This study and its recommendations do not necessarily reflect the opinions of the Thomas Jefferson Institute or its Board of Directors. It is offered as an additional tool in the on-going debate over education policy in Virginia. The creative alternatives suggested by the author should be seriously considered by those who make policy for our public education system including legislators, parents, teachers, business people, the media, and others.

Michael W. Thompson
Chairman and President
Thomas Jefferson Institute for Public Policy
February 21, 2000

Contents

Executive Summary.....	1
Introduction.....	5
The Problem.....	7
How Realistic is the Target?.....	15
Policy Recommendations.....	19
Appendix.....	23
A. Pass Rate Growth Curve Methodology	
B. Statewide Passing Rates in 1999	
About the Author.....	back cover

THE THOMAS JEFFERSON INSTITUTE FOR PUBLIC POLICY



Thomas Jefferson

Value-Added Accountability A Systems Solution to the School Accreditation Problem

Those committed to the purpose of the 1995 SOL program--rigorous *learning* standards leading to higher levels of academic achievement by Virginia's students--should endorse replacing a 1997 *accreditation* standard that threatens to undermine the fundamental reform it was intended to support. David Wheat, February 2000

Executive Summary

Virginia's Standards of Accreditation (SOA) require each public school to have at least 70 percent of its students passing all four Standards of Learning (SOL) tests by 2007 in order to retain accreditation. Statewide in 1999, only 6.5 percent of the schools met the SOA requirement, up from 2.2 percent in 1998.

The public has largely lost sight of the difference between the SOLs (*learning* standards for students) and the SOAs (*accreditation* standards for schools). Public support for both sets of standards has fallen while test scores have risen (Figure A).

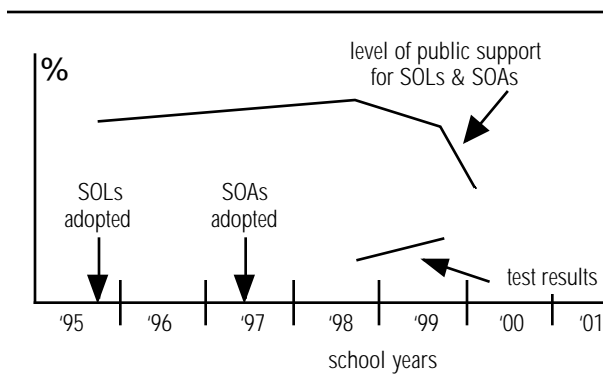


Figure A. Change in SOL test results and public support for the SOLs and SOAs. Public support trends estimated by the author.

The SOLs and the SOAs are separate issues, however, and preserving rigorous learning standards requires aggressive action to modify the accreditation goal.

The Board of Education is expected to vote on proposed SOA amendments in March, but the current proposals do not adequately address the problem associated with the 70 percent goal. Using a system dynamics approach to policy analysis, this study evaluates the accreditation policy and develops an alternative: Value-Added Accountability.

The SOA Problem. Dealing effectively with the accreditation policy problem requires identifying it explicitly, understanding how it developed, and perceiving its adverse effects on the standards of learning. All three requirements can be accomplished by contrasting the current SOL system with the one envisioned by those who developed the original program in 1995.

The original SOL system was supposed to produce annual improvements in student learning of content-rich knowledge and valuable skills. The hoped-for pattern of cause-and-effect can be summarized as follows:

- The SOLs would have a positive impact on classroom learning productivity as teachers gained experience teaching the standards and students gained capacity to learn more due to prior SOL instruction.
- Greater learning productivity would raise students' annual learning rates (i.e., the total knowledge and skills learned each year).

- Higher learning rates would be reflected in higher standardized test scores.

- Better test results would raise teacher and student motivation and boost learning productivity again, which would further enhance learning rates and test scores.

- Better test results would also raise public support for the learning standards.

- Greater support would minimize political pressures to change the standards or reduce their impact, and the SOLs would become a permanent feature in Virginia's education policy landscape.

That was how the system was *supposed* to work, and the pattern described above is diagrammed in a model of the SOL system in Figure B.

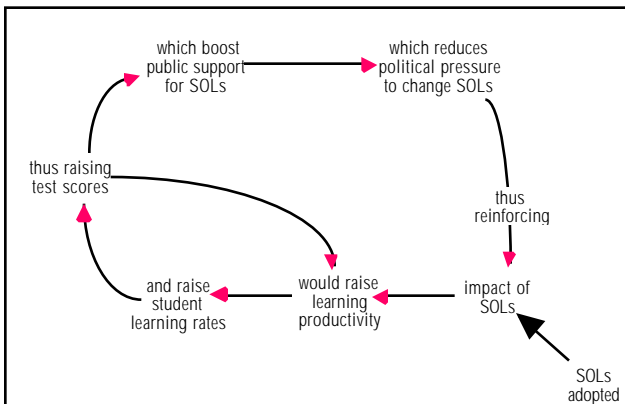


Figure B. The continuous cause-and-effect relationships *intended* when the SOLs were adopted in 1995.

In 1997, however, the Standards of Accreditation were amended with the addition of the “70 percent goal” for schools. An unintended side-effect of that goal was a change in the performance pattern of the SOL system; a change that has undermined rather than supported the learning standards.

The 70 percent goal raises parental expectations regarding acceptable test results each year. In effect, it creates an implicit local target for “expected test results.”

Whenever expected test results exceed actual test results, a “Gap” exists .

When the Gap grows, it has a depressing effect on teacher and student motivation, thereby reducing learning productivity and causing learning rates to be lower than they otherwise would be.

A growing Gap between expected and actual test results also frustrates parents, which lowers public support and increases political pressure to dilute or rescind learning standards branded “unrealistic.” That is the scenario illustrated in Figure C.

But is it the *learning* standards that are unrealistic, or is it the *accreditation* standard (i.e., the 70 percent goal) that is unrealistic? That distinction is too often overlooked in the public debate, and this study provides an answer to the question.

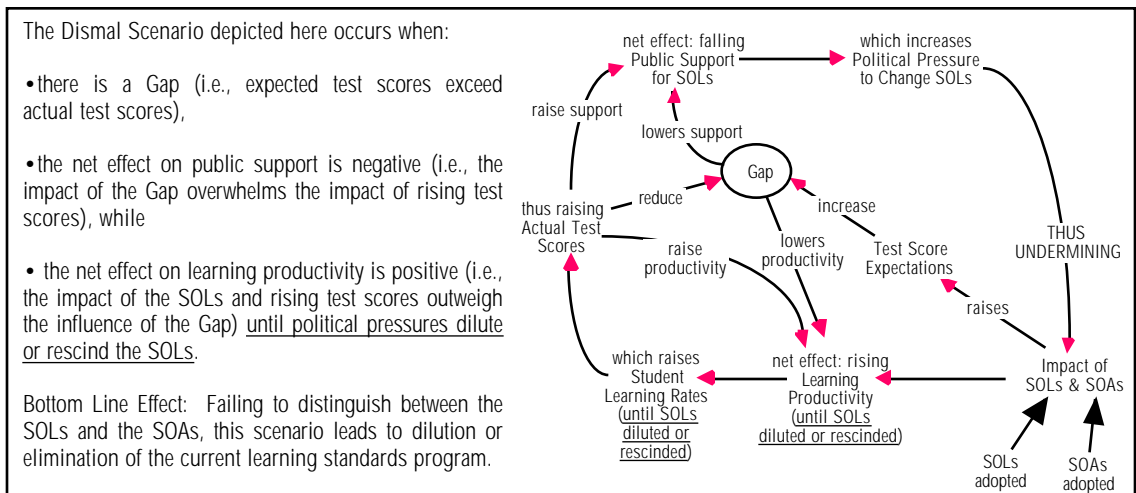


Figure C. The current SOL system showing unintended side-effects of the SOA 70 percent goal established in 1997.

How realistic is the SOA goal? Figure D helps answer that question by projecting the relationship between the statewide *student* pass rate (the percentage of Virginia's students passing all four tests) with the *school* pass rate (the percentage of schools having at least 70 percent of their students pass all four tests).

The shape of the growth curve in Figure D reflects the fact that students most likely to pass all four tests are disproportionately located in a few high achievement schools. For example, 66 percent of the schools that achieved the SOA goal in both 1998 and 1999 were located in just three school divisions having 16 percent of Virginia's schools. A school in Fairfax, Henrico, or Chesterfield county was ten times more likely to achieve the 70 percent goal than a school located elsewhere.

The findings in this study suggest that about 27 and 35 percent of Virginia's *students* reached their goal of passing all four tests in 1998 and 1999, respectively. In those same years, however, just 2.2 and 6.5 percent of the *schools* across the Commonwealth reached their 70 percent goal. The results for both years are shown in Figure D.¹

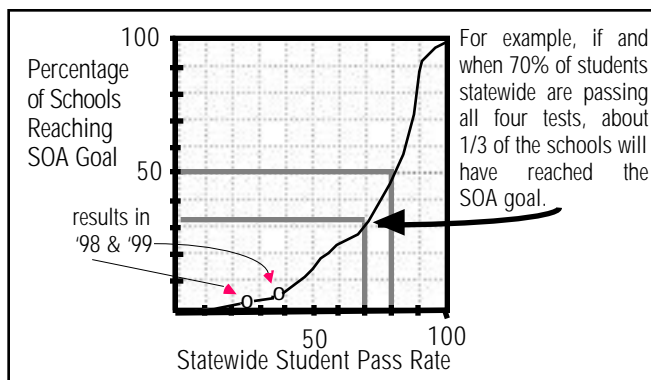


Figure D. The projected relationship between student pass rates and school pass rates. See Appendix A for details on derivation.

¹ The irregular shape in the lower center part of the curve reflects the bulk of schools in Fairfax, Henrico, and Chesterfield achieving the SOA goal. See Appendix A for details on the computer simulation derivation of the Figure D growth curve.

Figure D projects that only about one-third of the schools will reach the SOA goal even if 70 percent of the students in Virginia were to pass all four tests. Unless the statewide student pass rate exceeded 80 percent, it is unlikely that even half of the schools in the state would reach the accreditation goal.

The SOA goal for each school--having 70 percent of its students pass all four tests--is not a realistic goal for the majority of Virginia's public schools.

This spells trouble for the Standards of Learning and for all students who benefit from more challenging, rigorous learning standards. In most communities, parental expectations for their school's test results will be higher than actual test results year after year. Therefore, the resulting Gap in Figure C will be large, and will grow faster than test scores rise. Learning productivity and public support will decline, and political pressures to lower or rescind the standards will increase.

School Accountability. A new accreditation policy is needed to promote accountability while supporting the learning standards, rather than undermining them as current SOA policy does. The strategy suggested by this study is to repair the current SOL system by eliminating the unrealistic 70 percent goal and its side effects. That is, systemic surgery is needed to remove the Gap in Figure C, so that productivity and support will be affected only by changes in *actual* test results, rather than by comparisons with unrealistic *expected* test results. Such changes would restore the originally intended SOL system (Figure B).

Also, a new accreditation policy should assess the quality of *instruction* in schools rather than the quality of *students* in schools. The current policy rewards (or punishes) schools on the basis of reaching (or failing to reach) an arbitrary finish line without regard to the starting line. Instructional quality may actually be superior in a school that makes substantial progress

toward the SOA goal, compared to a school reaching it with large numbers of bright, self-motivated students requiring less innovative instructional methods to succeed. Which school deserves to lose accreditation? Neither.

There is something wrong with an accreditation policy that says 66 percent of the schools in Virginia currently deserving accreditation are located in just three counties having 16 percent of the state's schools. Any accreditation standard worthy of the label should not produce outcomes leading to such a distorted conclusion.

Accreditation should not depend on the students a school has. Rather, it should depend on what a school does with the students it has.

Consistent with this principle is an accreditation policy based on *value-added accountability*, which means holding schools responsible for performance improvements in each class cohort² that rises from one level to the next in a school system.

To illustrate, consider a cohort of students who are now in the 5th grade. They will take the 5th grade SOL tests this spring. The effectiveness of their elementary school should be evaluated by comparing this year's 5th grade pass rates in each category of tests (e.g., math) with the pass rates achieved by the same cohort of students when they took the 3rd grade SOL tests in 1998. Looking ahead to 2003, the middle school should be evaluated by comparing its 8th grade SOL pass rates that year with this year's 5th grade SOL pass rates for the same cohort.

Since high school SOL tests are end-of-course tests, not all students taking tests will be in the same grade. Therefore, to measure value-added at that level, each student's performance (pass or fail) should

² A cohort consists of students at the same grade level in a particular school. In localities with high student turnover, the policy would have to operate in a way that minimized distortions resulting from mere changes in the composition of cohorts.

be compared to that student's 8th grade performance. The aggregate improvement rate for the school could then be calculated.

Schools that fail to add value consistently (according to Board of Education definition) should be sanctioned, and be subject to losing accreditation.³

RECOMMENDATION 1. Amend the SOAs so that schools will be accredited on the basis of improvement in class cohort pass rates on individual SOL tests.

Student Accountability. SOA policy also requires secondary students to pass end-of-course SOL tests to earn certain graduation credits, beginning with the Class of 2004. The timetable for holding students accountable should be amended to reflect the fact that the seniors in 2007 will be the first class with twelve years of SOL instruction.

RECOMMENDATION 2. Amend the SOAs so that end-of-course SOL test requirements apply initially to students in the graduating class of 2007, and to each class thereafter.

Conclusion. A value-added approach to accountability would restore the SOL principle of cumulative learning growth. Moreover, with the focus on strengthening class cohorts, the key "expectation" would be for test score improvements. There would be none of the adverse side effects resulting from comparisons with unrealistic targets. Teachers and students could tackle the SOLs in a spirit of discovery rather than an aura of anxiety.

³ If desired, a school could still be "graded" according to annual SOL test performance, but such a report card should be interpreted primarily as an indicator of the "academic ability" of the current student body and only secondarily as an instructional quality measure (similar to the way athletic teams are perceived each year). It should *not* be a criterion for accreditation.

Introduction

To foster *school* accountability for effective implementation of the Standards of Learning (SOL) in Virginia, current Standards of Accreditation (SOA) require that individual public schools have at least 70 percent of their students passing all four SOL tests by the end of the 2006-07 school year in order to retain accreditation. *Student* accountability is the goal of the SOA policy that requires secondary students to pass end-of-course SOL tests as a prerequisite for certain high school graduation credits, beginning with the Class of 2004.

In 1999, only 6.5 percent of the schools achieved the SOA 70 percent goal (up from 2.2 percent in 1998). In most school divisions, local officials and parents are increasingly worried that their schools will not achieve the accreditation goal or that large numbers of seniors will not meet their graduation requirements, despite the rise in scores in 1999 and the prospects for substantial improvement in overall student performance on SOL tests over the next several years.

Indeed, the public has largely lost sight of the difference between raising *learning standards for students* and raising *accreditation standards for schools*. The paradox of rising test scores and falling public support is sketched in Figure 1. Think of the graph as a picture of a story unfolding rather than as a precise gauge. The direction of change is more important to the story than the quantitative precision, and here is the gist of the story: After the adoption of the SOLs in 1995, public support for the more rigorous standards rose gradually until falling in 1998, when the first test results were lower than expected. Support declined even more sharply in 1999, despite considerable improvement in the test scores.

Those attentive to education policy in Virginia may disagree on the the *slope* of the lines drawn in Figure 1 (i.e., the pace of change), but most will agree on the *direction*

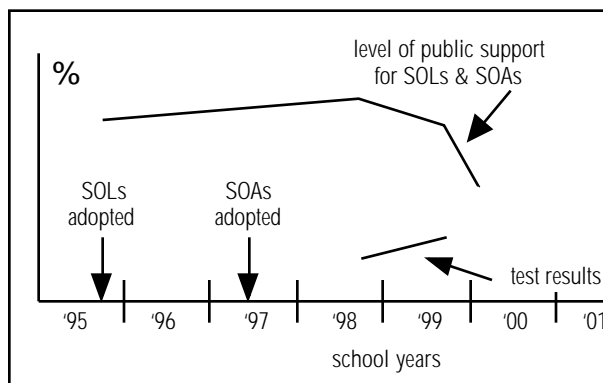


Figure 1. Change in SOL test results and public support for the SOLs and SOAs. Public support trends estimated by the author.

during the past five years. Between 1995 and 1998, the principle of holding students and schools to more rigorous academic standards seemed to be accepted gradually by more and more citizens of the Commonwealth.

The SOA 70 percent goal was established in 1997, but generated little concern at the time since no tests had been given. The first test results in 1998, however, brought a wake-up call, and public support declined a little. Despite improved test results the next year, the decline in support probably accelerated in 1999 because the dismal 1998 results had been discounted by many as a “start up” situation, while the still-lower-than-expected 1999 results received no comparable benefit of the doubt.⁴

Pressure for adjusting either the SOA goal or timetable has been building since the first round of testing in 1998. The Board of Education held its most recent hearings on these issues in several communities across the Commonwealth from November to January. Subsequent to the November hearings, Board President Kirk Schroder

⁴ On the contrary, the 1999 improvements were probably discounted by some who believed that the higher scores included one-time, quantum adjustments by teachers and students in terms of instructional strategies and test-taking skills, and that such adjustments would be incremental in later years.

wrote seven public education advocacy organizations⁵ that had jointly criticized the use of SOL tests for accountability purposes, inviting *them* to specify how *they* would design an accountability program.

Members of the Board of Education are justifiably concerned about the escalating attacks on the SOLs and SOAs, particularly when the raw data suggest that real progress is being made in upgrading students' knowledge and skills.

Compared to 1998 results, 1999 statewide average scores improved on all 27 SOL tests administered to 3rd, 5th, and 8th graders and high school students. Even 60 percent of the schools improved their students' scores on the history tests, where performance has been the weakest. The number of schools passing all four tests tripled, from 39 to 116 (although the percentage of schools reaching that SOA goal was still extremely low).⁶

Those of us who were part of the team of teachers and Board members who framed the SOLs in 1994-95 believed at the time--and still believe today--that Virginia's public school students need to reach a higher level of academic achievement. Those who later developed the SOL testing program and those who promulgated the SOA goal shared similar convictions.

Given the opportunity, Virginia's students should continue to make progress toward the learning goals of the 1995 *SOLs*, even if most schools don't actually reach the accreditation goal of the 1997 *SOAs*.

⁵ The Virginia Association of Elementary School Principals, the Virginia Association of School Superintendents, the Virginia Association of Secondary School Principals, the Virginia Congress of Parents and Teachers, the Virginia Education Association, and the Virginia School Counselor Association, and the Virginia Counselors Association.

⁶ Virginia Department of Education (VDOE) press release, August 13, 1999.

However, concern over the accreditation standards has weakened public support for the SOL program and has jeopardized the future of the rigorous learning standards .

The SOLs and the SOAs are separate issues, however, and preserving the SOLs (standards that have been judged among the best in the nation in three⁷ subject areas) requires aggressive remedial steps to modify the accreditation goal.

The Board of Education is expected to vote on proposed SOA amendments in March, but the current proposals do not adequately address the problem associated with the 70 percent goal.

Using a system dynamics approach to policy analysis, this study evaluates the accreditation policy and develops an alternative: *value-added accountability*. The findings of the study are presented in three parts. First, the report clarifies the problem by contrasting the way the SOL system was *supposed* to work with the way it is actually operating today. Particular attention is given to the unintended, adverse side-effect of the SOA 70 percent goal.

Next, the 70 percent goal is shown to be an unrealistic target for most schools, which intensifies the adverse side-effect and threatens the future of the SOL program.

Finally, a new accreditation policy is recommended, one that is consistent with the desired performance of the SOL system, that insures accountability, and that supports rather than undermines rigorous learning standards.

⁷ The Fordham Foundation analyzed learning standards in all fifty states, and assigned these "grades" to Virginia's SOLs: History--A, English--B, Math--B, Science--D, and Geography--D. For an extensive summary of the Fordham findings, see the appendix in *Y2K Priorities for K-12*, D. Wheat (Thomas Jefferson Institute for Public Policy, Oct. 1999).

The Problem

Dealing effectively with the accreditation policy problem requires identifying it explicitly, understanding how it developed, and perceiving its adverse effects on the standards of learning. All three requirements can be accomplished by contrasting the current SOL system with the one envisioned by those who developed the original SOL program in 1995.⁸

The original SOL system was supposed to produce annual improvements in student learning of content-rich knowledge and valuable skills. The hoped-for pattern of cause-and-effect can be summarized as follows:

- The SOLs would have a positive impact on classroom learning productivity as teachers gained experience teaching the standards and students gained capacity to learn more due to prior SOL instruction.
- Greater learning productivity would raise students' annual learning rates (i.e., the total knowledge and skills learned each year).
- Higher learning rates would be reflected in higher standardized test scores.
- Better test results would raise teacher and student motivation and boost learning productivity again, which would further enhance learning rates and test scores.
- Better test results would also raise public support for the learning standards.
- Greater support would minimize political pressures to change the standards or reduce their impact, and the SOLs would become a permanent feature in Virginia's education policy landscape.

⁸ The purpose of the diagrams in this section is to provide visual reinforcement of the explanation in the text. If the diagrams help, use them. If not, focus on the text. Feel free to contact the author with questions about the diagrams or anything else in this report. (See inside back cover for contact information.)

That was how the system was *supposed* to work, and the pattern described is diagrammed in a model of the SOL system in Figure 2.

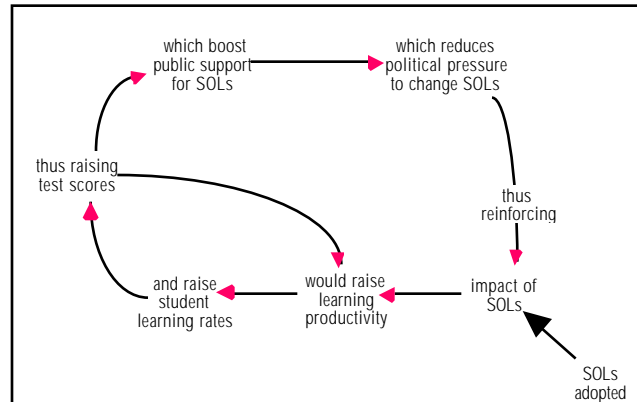


Figure 2. The continuous cause-and-effect relationships *intended* when the SOLs were adopted in 1995.

Understanding the difference between the 1995 SOL system in Figure 2 and the system operating today requires some familiarity with two conceptual building blocks: (a) cause-and-effect and (b) feedback.

While the concept of cause-and-effect is familiar to the reader, the diagrams in this report may not be. Therefore, the full model of the SOL system is developed in stages, beginning with the simplest cause-and-effect relationships. Feedback, as the term is used in system dynamics, may be a less familiar concept. Again, simple illustrations precede more complex representations of dynamic system feedback.

Cause and Effect

Implicit in any policy--whether in business or government--is the concept of cause-and-effect. A new policy (the "cause") is intended to produce some beneficial change (the "effect") in the *status quo*. The higher learning standards adopted in 1995, for example, were intended to have a positive impact on student acquisition of knowledge and skills.

Such cause-and-effect relationships can be diagrammed, albeit simplistically, as in Figure 3.

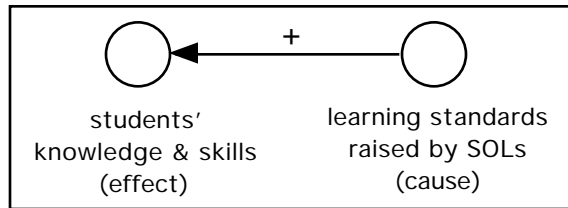


Figure 3. Implicit cause-and-effect relationship between higher learning standards and knowledge and skills gained by students. The plus (+) sign means that a change in the learning standards causes a change in student learning in the *same direction*. An increase would cause an increase, and a decrease would cause a decrease.

The arrow in the diagram indicates the direction of causality (i.e., “the learning standards” have an impact on “students’ knowledge and skills.”). The plus sign (+) indicates a positive correlation between the cause and the effect (i.e., *raising* the learning standards causes an *increase* in students’ knowledge and skills, and a *decrease* in the former causes a *decrease* in the latter.) Had there been a minus (-) sign, it would have meant that *increasing* one factor caused a *decrease* in the other, and conversely.

Certainly, no one working on the SOLs in 1994-95 believed that mere adoption and publication of higher standards by the Board of Education would automatically lead to higher levels of learning by students. Thus, the model in Figure 3 simplifies the assumed cause-and-effect relationship by leaving out well known intermediate factors such as teacher ability and motivation to emphasize the new standards and develop effective lessons, student capacities and motivation to learn the SOL content, and resources necessary to enhance both teaching and learning.⁹

⁹ Based on the author’s involvement in that process, the significance accorded these intermediate factors varied considerably among participants. When the SOLs were published, unaccompanied by either resource materials or implementation strategies, many teachers and administrators wondered whether we had given *any* consideration to the intermediate factors.

The interaction of these intermediate factors constitutes the “learning productivity” factor in the center of Figure 4, which should be interpreted as follows: The impact of higher standards causes learning activities to be more productive (quantitatively and qualitatively), which leads to more learning per year (i.e., a higher learning rate).¹⁰

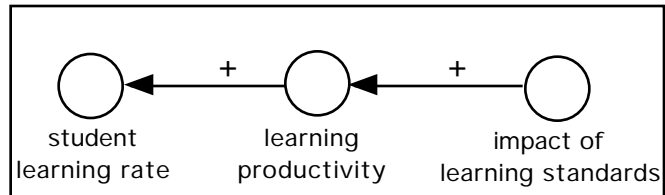


Figure 4. Learning productivity is the combined influence of teacher, student, and resources for instruction. The student learning rate is the annual gain in knowledge and skills.

Feedback

Even in Figure 4, however, the overall single-direction causality remains. That is to say, the model--and the implicit thinking behind it--does not reveal any feedback potential. It still implies a one-way system, meaning that the 1995 policy (i.e., the new SOLs) would always be a “cause” and would never be affected by the dynamics of the system.

The system dynamics approach to policy analysis, on the other hand, assumes that any policy is part of a system that, sooner or later, generates new issues due to perceptions of the policy’s effectiveness or side-effects. The education policy that raised Virginia’s learning standards is no exception

¹⁰ Within the circle labeled “learning productivity” in Figure 4 is a complex sub-system of teacher and student capabilities and motivation and instructional resources. If it were necessary to specify the structural components of that sub-system, we could “zoom” down to that level and do so. However, while extremely important to student learning rates, the interaction of those factors is not something within the sphere of direct influence by the Board of Education’s accreditation policies. Therefore, going to that level of detail is not necessary for our purpose; nor is it desirable due to the complexity it would add without corresponding gains in understanding of the system dynamics of interest in this study.

to this normal systemic feedback process. The diagram in Figure 5 displays such feedback effects.

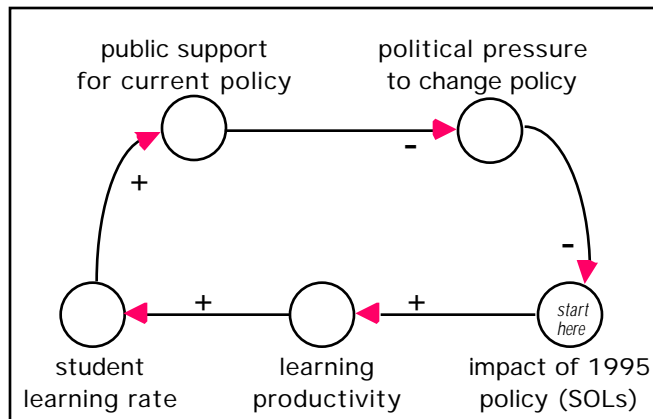


Figure 5. Feedback in the SOL policy system. Minus (-) signs mean that the cause and effect move in opposite directions. Thus, an increase in public support would cause political pressure to decline. A decline in political pressure would then increase the impact of the SOLs on learning productivity.

This model's simplicity stems from its omission of factors that explain how policy effects change political support levels and how government institutions generate new public policies. In this report, complexity will be added to the models a little at a time and only when necessary.¹¹

In plain English, starting¹² with the impact of the 1995 policy (i.e., the SOLs), the Figure 5 model says:

- The impact of the SOLs makes learning activities more productive;
- Higher learning productivity raises the student learning rate;

¹¹ Computer simulation of the SOL model (downloadable at <http://www.wheatresources> and <http://www.thomasjeffersoninst.org>) requires many more details than necessary to understand the basic dynamics of the system, which is our goal here.

¹² The "starting point" in reading such diagrams can be puzzling at times because one presumes that a "correct" starting point exists. In principle, one may start at any point and follow the logic around the loops. In practice, however, it is a good idea to start where a change has taken place; in this case, the raising of the standards by the SOLs.

- When learning rates rise, that boosts public support for the SOLs;
- Growing support reduces the political pressure for a policy change.
- A reduction in pressure for change increases the credibility and, therefore, the impact of the SOLs.¹³

The next step in the unveiling of the model of the 1995 SOL system is to display the impact of standardized test results.

Ideally, the mere designation of the SOLs as mandatory would be sufficient to produce the desired performance in schools. However, the framers of the SOLs believed that accountability would be fostered by a testing program that would gauge learning progress and positively reinforce the incentives for schools and students (i.e., produce effects in the same direction as the SOL impact). Thus, from the beginning, a testing program was envisioned by those who developed the SOLs, even though the actual tests were designed by a different group and adopted at a later date.

On the next page, Figure 6 illustrates the expected impact of test results when the SOL program was adopted in 1995. It was envisioned that test results would show regular improvements, at least during the first decade of the program. Rising test scores, in turn, were expected to raise public support for the SOLs, plus contribute to an increase in learning productivity by boosting the morale of teachers and students.

On a parallel track, learning productivity would also experience annual growth as teachers improved their SOL instructional effectiveness with experience, and students became increasingly capable of learning more due to SOL instruction in prior years. Higher productivity would generate a

¹³ On the other hand, falling political support would increase the pressure for a policy change and would reduce the impact of the SOLs, either by undermining their credibility in the classroom, or diluting or rescinding them by regulation or statute.

new round of higher learning rates, which would be reflected in higher test scores. Better test results would raise support in the communities and productivity in the schools, and the result would be another increase in the learning rate the following year. A “virtuous upward spiral” would have been set in motion.¹⁴

The diagram in Figure 6 may be thought of as the “general model” of the 1995 SOL system. It could lead to both desirable or undesirable performance. For example, if something were to cause learning productivity to fall, then learning rates would fall, test scores would fall, public support would fall, and that would increase political pressure to alter the SOL program.

On the other hand, the diagram in Figure 7 (a reproduction of Figure 2 to permit comparison without going to another page),

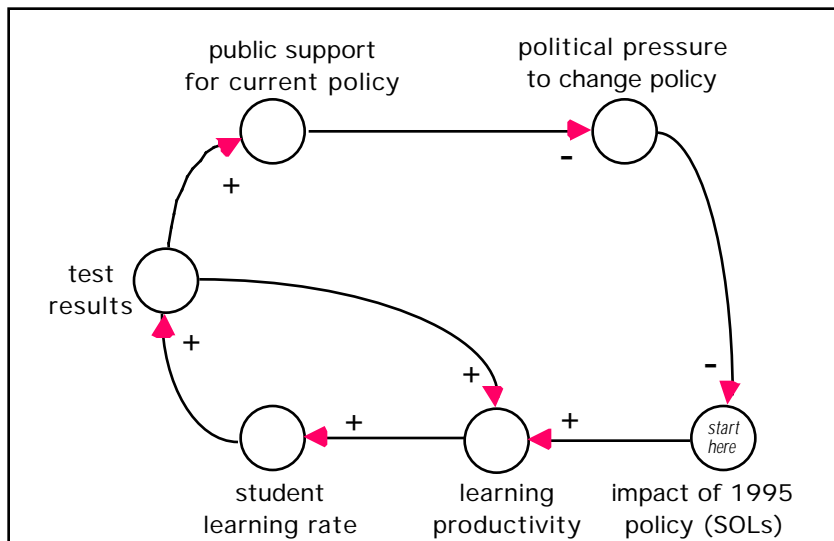


Figure 6. General SOL model showing the original conception of the test effects. Improvements in test results would cause an increase in public support for the SOLs, as well as an increase in learning productivity by boosting teacher and student morale.

¹⁴ Productivity growth, however, cannot be expected to increase forever. Eventually, the learning capacities of students, the instructional skills of teachers, or the effectiveness of instructional resource materials--or all three--will grow at a slower rate or not at all. When any of these limits begins to curtail productivity and learning rates, the system will generate pressures for changes in policy. (In principle, there is also an absolute upper limit to test scores, although that is unlikely to become a binding constraint.)

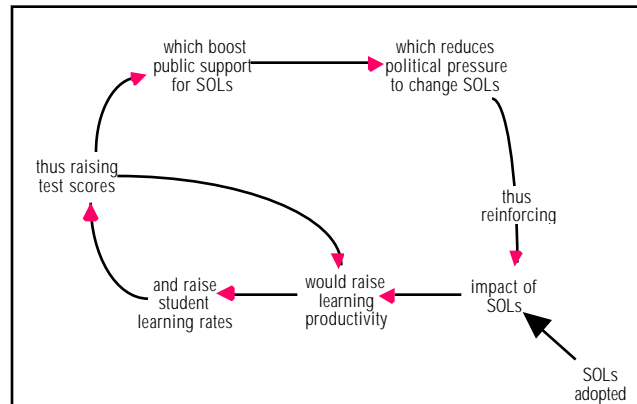


Figure 7. The scenario envisioned for the SOL system in 1995, a special “best case” version of the general model in Figure 6.

illustrates the optimistic scenario envisioned by the developers of the SOLs (i.e., the way the system was *supposed* to work).

The models in Figures 6 and 7 can't be telling the whole story, however, because the dilemma confronting the Board of Education is *falling public support* (with its attendant political consequences) amidst *rising test scores that imply improvement in student learning*. In short, the system modeled in Figures 6 and 7 cannot account for the real-world performance of the SOL system. Something critical is still missing.

The missing elements of the system model are those that were put in place with the adoption of the Standards of Accreditation (SOA) 70 percent goal in 1997.

The Current System

The SOAs raised school performance standards by establishing a long-term goal for test results (70 percent of a school's students passing all four tests by 2007). *An unintended side-effect was a change in the performance pattern of the SOL system; a change that has undermined rather than supported the learning standards.*

The 70 percent goal raised expectations--among parents, the general public, and the media--regarding acceptable test results each year, locally and statewide. In effect, it created annual targets for “expected test results.”

At first glance, expecting 70 percent of the students to pass all four tests seems reasonable and achievable. Of course, few if any parents anticipated that their local schools would reach the SOA goal overnight. Nevertheless, it is likely that the expected test results during the first two years have been much closer to the 70 percent mark than is realistic.

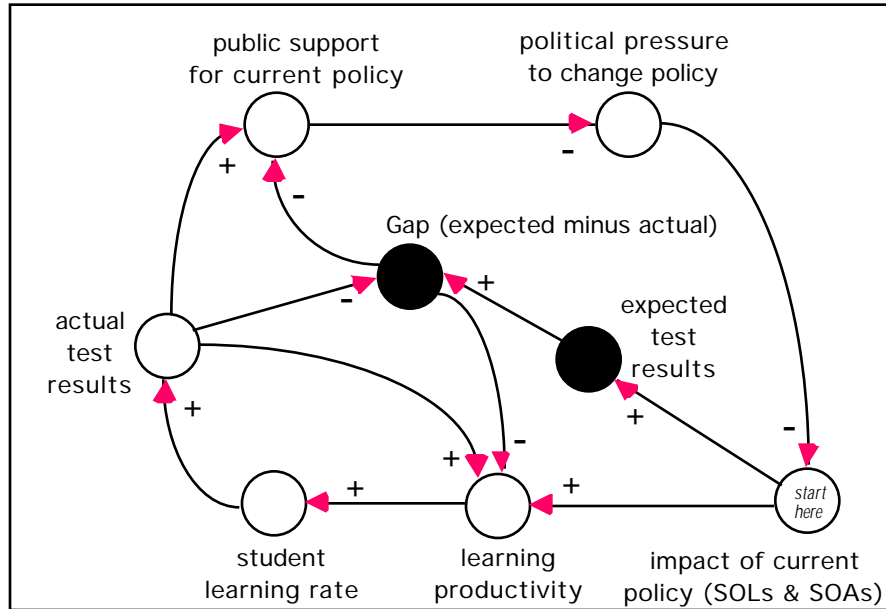


Figure 8. The general version of the current SOL system, showing unintended side-effect of the SOA 70 percent goal established in 1997. Note that public support and learning productivity are influenced by both positive and negative feedback, and the net effects depend on the relative strength of those feedback loops.

Moreover, those parental expectations are likely to rise each year, along with their impatience for more rapid progress toward the long-term goal. Indeed, the implicit local test result targets are likely to rise faster each year than actual improvements in test scores.

Whenever expected test results exceed actual test results, a “Gap” exists.

The general version of the SOL system operating today is illustrated in Figure 8, and the diagram reveals how a Gap emerges when expected test results exceed actual test results.

Note carefully the negative effects of the Gap, which could counteract the positive effects of rising test scores on both learning productivity and public support.

When the Gap grows, it has a depressing effect on teacher and student motivation, thereby reducing learning productivity and causing learning rates to be lower than they otherwise would be.

On the other hand, as long as actual test results continued to improve in absolute terms (i.e., without comparing them to expected test results), productivity would be receiving upward boosts, and learning rates would be propped up.

Likewise, the level of public support for the SOLs is affected positively by the test results and negatively by the Gap between the expected and actual test results.

Improvement in test scores (without reference to any target) would bolster public support. A growing Gap, on the other hand, would continue to frustrate parents and lower public support.¹⁵

¹⁵ A persistent Gap--whether growing or not--may be just as damaging to public support. Social phenomena are often simplified as “win or lose” outcomes, and the persistent failure of large numbers of schools to measure up to expectations despite actual improvements in performance will undoubtedly affect public evaluation of the schools *or the standards that make schools appear to be losers.*

Declining public support affects the political climate and landscape, and increases the pressure for policy changes that would lower the standards--*both SOAs and SOLs as long as the two are inseparable in the public mind*. Such reactive policies would lower the standards and eventually cause learning rates to decline.

This depressing scenario is illustrated in Figure 9, which is a special case of the general model in Figure 8.

potential is realized depends on the prospects for large differences between expected and actual test results (i.e., the size of the Gap), an issue examined in detail in the next section of this report.

Thus, the original SOL goal of students learning more at each grade level every year could be undermined in two ways as a result of the SOAs, *even when learning rates and test scores are on the rise*.

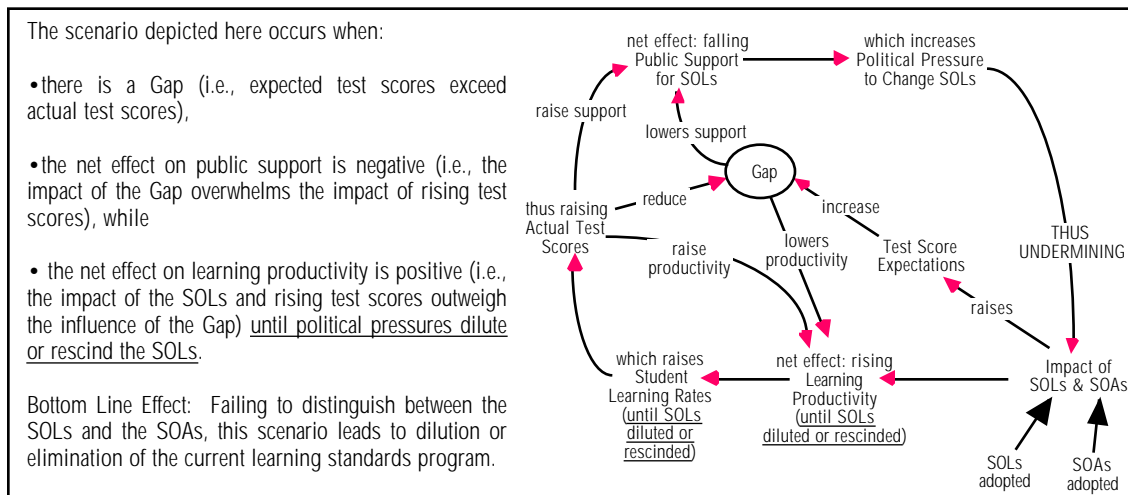


Figure 9. The Dismal Scenario: A “special case” of the performance of the current SOL system, where public support falls in spite of improvements in test scores, and political pressures undermine the impact of the SOLs and SOAs. The impact of the SOA 70 percent goal causes expected test results to be higher. Higher expectations increase the Gap, which lowers public support and triggers the adverse chain of events that undermine the SOLs.

The scenario illustrated in Figure 9 is not inevitable, of course. The actual performance of the current SOL system depends on the relative strength of the feedback loops influencing learning productivity and public support.¹⁶

For the moment, however, it is important to note the *potential* for counter-productive effects of the long-term goal established by the SOAs. Whether that

¹⁶ The net effects cannot be measured directly, but can be inferred as the system operates in real life. Also, different assumptions about the relative strength of the feedback loops can be investigated by computer simulation techniques. The results of such simulated experiments are available on the internet at <http://www.wheatresources.com> and at the web site of the Jefferson Institute: www.thomasjeffersoninst.org.

The negative effects of a Gap between expected and actual test results could overwhelm the positive effects of actual improvements in test scores, with the result being lower learning productivity in the classrooms and lower public support in the communities.

Both developments eventually lead to lower learning rates, either in the short run by falling productivity or in the long run as political pressures mount to “do something about those unrealistic standards.”

But is it the *learning* standards that are unrealistic, or is it the *accreditation* standard (i.e., the 70 percent goal) that is unrealistic? That distinction is too often overlooked in the public debate. The next

section of the report provides an answer to that question by examining whether the SOA “70 percent goal” is a target within reach by a majority of Virginia’s public schools.

The realism of that SOA “70 percent goal” has a direct bearing on the realism of parents’ expectations for test results (and the resulting size of the Gap) and the relative strength of the critical feedback loops in the system. The realism of that goal determines which scenario is likely to emerge from the general model of the SOL system in Figure 8:

The “Up” Scenario: If the goal proves to be realistic, there will be steady increases in learning rates as the SOLs gain public support and increase their classroom impact.

The “Down” Scenario. If the goal is not realistic, learning rates will fall as SOLs lose support in the communities and credibility in the classroom, and are eventually diluted or rescinded.

How Realistic is the Target?

The high leverage point in today's SOL system is the Gap between actual test results and expected test results. That is where the system's dynamic relationships have the potential to reverse the virtuous upward spiral envisioned in 1995.

From the Gap flows the potential negative forces that could reduce learning productivity in the schools and public support in the communities, and start a vicious downward spiral of the entire SOL program.

The positive impact of rising test scores on learning productivity and community support would probably offset the negative impact of a small Gap, and keep the SOL program on course. However, a large Gap, particularly one that increases yearly, spells trouble for the SOLs. To get a handle on the prospects for the Gap, we need to estimate the realistic prospects for reaching the SOA goal. That has a direct bearing on the realism of the expectations for test results in local communities. More realistic expectations would produce smaller Gaps.

When the SOL assessment tests were first administered in the spring of 1998, only 2.2 percent of Virginia's schools achieved the SOA goal (i.e., had 70 percent of their students passing all four SOL subject area tests). In the 1999 round of testing, scores improved considerably, but the number of schools "passing" was still only 6.5 percent of the total.

As this analysis progresses on the next few pages, it will be important to remain clear on the distinction between (a) the percentage of *schools* in which at least 70 percent of the students passed the tests in all four subject areas, (b) the percentage of *students* who passed specific tests.

The 1998 and 1999 statewide "pass rates" for *students* on all tests in various grades are included in Appendix B.

However, the table in Figure 10 provides a composite summary of those pass rates in the four subject areas:

Test_yr	Percentage of Students Passing at Each Grade Level			
	3	5	8	HS ¹⁷
English 98	53	67	66	72
English 99	61	75	69	78
Science 98	63	59	71	61
Science 99	68	67	78	70
Math 98	63	47	53	41
Math 99	68	51	60	56
History 98	49	33	35	44
History 99	62	46	40	49

Figure 10. Percentage of students passing each category of tests, by grade level, in 1998 and 1999. (Source: VDOE press release, July 1999)

Compared to 1998, a higher percentage of students passed in every category of testing in 1999. When percentages across grade levels are averaged, here is the approximate percentage of students passing each set of tests in 1999:

English	70%
Science	70%
Math	60%
History	50%

What is the outlook for most schools reaching the 70 percent target, either in the short run or by the end of the 2006-07 school year? How realistic is that goal?

¹⁷ For high school end-of-course tests, the percentage for a subject area (e.g., math) is the unweighted average of the passing rates for tests in that area (e.g., algebra I, algebra II, and geometry).

Those who are most optimistic tend to describe the challenge this way:

“Achieve passing levels on math and history by the 10-20 percent who failed those tests (while also maintaining English and science pass rates at 70 percent or above and raising performance by those students who are still unlikely to pass).”

However, even if 70 percent of the students statewide eventually passed the four tests, there is troubling evidence that only a small percentage of the schools would be reaching the SOA goal at the same time.

This is due to the unequal geographic distribution of students who are most likely to pass the tests. In a vivid example of the “80/20 Rule”, a majority of the students passing all four tests are disproportionately located in a few high achievement schools.¹⁸

Sixty-six percent of the schools that achieved the SOA goal in both 1998 and 1999 were located in just three school divisions having 16 percent of Virginia’s schools. In 1999, 26 percent of the schools in Fairfax, Henrico, or Chesterfield county met the SOA goal, in contrast with 2.6 percent of the rest of the schools in the state.¹⁹

¹⁸ In general terms, the “80/20 Rule” says that a large percentage (e.g., 80%) of significant events will occur in a small percentage (e.g., 20%) of the possible cases. For example, a large majority of a company’s profits will come from a small minority of its customers. In schools, a large majority of the disciplinary problems will be caused by a small minority of the students. Widely acknowledged in business management literature for its relevance, the concept was discovered by Italian economist Vilfredo Pareto in the late 19th century and receives in-depth treatment in *The 80/20 Principle* by Richard Koch (Doubleday: 1998)

¹⁹ Individual school SOL test results were obtained from the August 13, 1999 VDOE press release, while the county school division data were obtained from their individual web sites on the internet.

A school in those three counties was 10 times more likely to achieve the 70 percent goal than a school elsewhere in the Commonwealth.

Of course, the 10 to 1 ratio is not carved in stone, nor is the disparity between the statewide student pass rate and school pass rate. Both ratios would decline as more students passed the four tests statewide, but not at a constant rate, due to the disproportionate number of “passing students” in a few school divisions.

On the next page, the graph in Figure 12 indicates that the change would be slow at first and then accelerate if statewide student pass rates ever approached 100 percent. At that limit, obviously, with every student in the state passing all four tests, then every school would have reached the SOA goals.

The findings in this study indicate that about 27 and 35 percent of Virginia’s students reached their individual goal of passing all four tests in 1998 and 1999, respectively. The average of the pass rates on the four tests was 54 and 62 percent in those years. The *student* performance in 1998 and 1999, however, translated into just 2.2 and 6.5 percent of the *schools* reaching their 70 percent goal in those two years, as illustrated in Figure 12.²⁰

In Figure 12, the horizontal axis represents the average of student pass rates on the four SOL tests. The vertical axis is the percentage of schools that reach the SOA 70 percent goal. The curve on the graph shows the relationship between the two percentages.

²⁰ The 27 and 35 percent figures refer to the percentage of students reaching their own goal: passing all four tests. The 54 and 62 percent figures refer to the average of the student pass rates on the four tests (i.e., the average of the percentage passing math, the percentage passing English, the percentage passing history, and the percentage passing science). See Appendix A for details on the derivation of both student pass rate figures. Appendix A also explains the relationship between Figure 12 on page 17 and Figure D on page 3, the difference being due to the two measures for student pass rates.

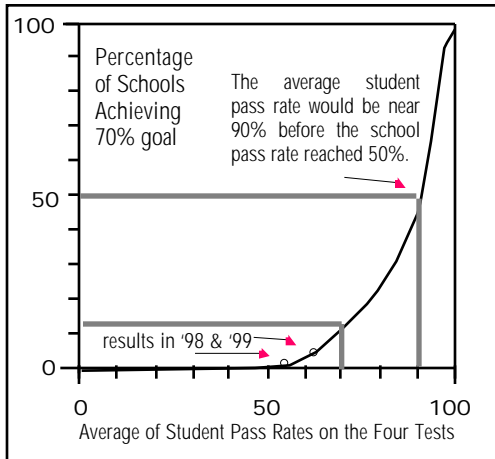


Figure 12. The projected relationship between average student pass rates and school pass rates, based on statistical regression analysis of 1998 and 1999 data for all elementary and middle schools (which account for over 80 percent of all schools and 90 percent of the schools achieving the SOA goal thus far. (See footnote 20 and Appendix A.)

From the 70 percent mark on the horizontal axis in Figure 12, a shaded vertical line has been drawn. At the curve, it meets another shaded line from the left axis.

Less than 15 percent of Virginia's schools are expected to be reaching the SOA goal when the average of student pass rates on the four tests reaches the 70 percent level statewide.

Higher on the curve, a shaded line from the 50 percent school pass rate mark intersects a shaded line from the 90 percent student pass rate mark.

This suggests that the statewide average of student pass rates on the four tests could approach the 90 percent level before even half of the schools in the state reach their SOA goal.

The graph in Figure 12 says nothing about the likelihood that student pass rates will actually reach particular levels. It merely projects what the corresponding school pass rate would be at various levels of student performance.

However, it should be clear that the accreditation of many (and perhaps more than half) of Virginia's schools will be in jeopardy even if Virginia's students statewide do even better than the goal established by the Board of Education!

Given the current average student pass rate of 62 percent and the improvement required to take it to the 80-90 percent range, an important conclusion also becomes clear:

The SOA goal for each school, while admirable for all schools and possibly attainable by many in the long run, is not a realistic goal for the majority of Virginia's public schools in the time frame contemplated under current policy.

Because the SOA 70 percent goal is unrealistic in the short run, test result expectations tied to that goal will also be unrealistic in the short run. Consequently, in most localities, parental expectations for their school's test results will almost certainly be higher than actual test results year after year. That means the Gap between actual and expected test results will be persistent and large, even when actual test scores are on the rise. Learning productivity in the schools and public support will be depressed, political pressures to lower or rescind the standards will increase, and the SOLs will face extinction.

The last section of the report contains policy recommendations aimed at avoiding this dismal scenario.

reaching (or failing to reach) an arbitrary finish line without regard to the starting line. Instructional quality may actually be superior in a school that makes substantial progress toward the SOA goal, compared to a school reaching the goal with large numbers of bright, self-motivated students requiring less innovative instructional methods to succeed. Which school deserves to lose accreditation? Neither.

There is something wrong with an accreditation policy that says 66 percent of the schools in Virginia currently deserving accreditation are located in just three counties having 16 percent of the state's schools. Any accreditation standard worthy of the label should not produce outcomes leading to such a distorted conclusion.

Accreditation should not depend on the students a school has. Rather, it should depend on what a school does with the students it has.

Consistent with this principle is an accreditation policy based on *value-added accountability*, which means holding schools responsible for performance improvements in each class cohort²² that rises from one level to the next in a school division.

To illustrate, the cohort of students who are now in the 5th grade will take the 5th grade SOL tests this spring. The effectiveness of an elementary school should be evaluated by comparing this year's 5th grade pass rates in each category of tests (e.g., math) with the pass rates achieved by the same cohort of students when they took the 3rd grade SOL tests in 1998.²³ Looking ahead to 2003, the middle school should be

²² A cohort consists of students at the same grade level in a particular school. In localities with high student turnover, the policy would have to operate in a way that minimized distortions resulting from mere changes in the composition of cohorts.

²³ To avoid incentives for "low" 3rd grade scores that would inflate "improvement" at the 5th grade level, it would be necessary to calculate a base period 3rd grade score, using 1998 and 1999 3rd grade scores.

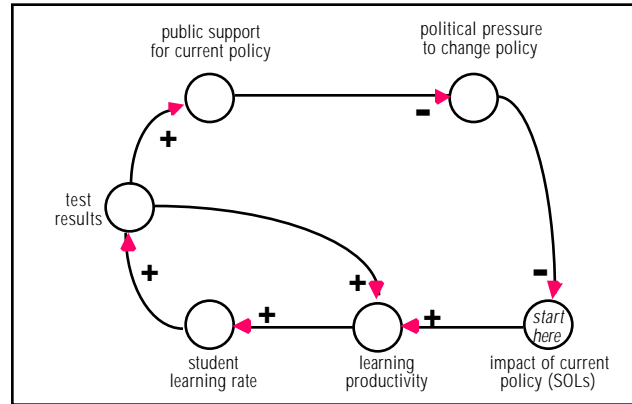


Figure 14. After systemic surgery: restoration of the continuous cause-and-effect relationships of the system intended by the 1995 SOLs.

evaluated by comparing its 8th grade SOL pass rates that year with this year's 5th grade SOL pass rates for the same cohort.

Since high school SOL tests are end-of-course tests, not all students taking tests will be in the same grade. Therefore, to measure value-added at that level, each test-taking student's performance (pass or fail) should be compared to that student's 8th grade performance, and the aggregate improvement rate for the school could then be calculated.

Schools that fail to add value consistently (according to Board of Education definition) should be sanctioned, and be subject to losing accreditation.²⁴

RECOMMENDATION 1. Amend the SOAs so that schools will be accredited on the basis of improvement in class cohort pass rates on individual SOL tests.

The first edition of this report has generated a healthy debate between those those who support this recommendation and

²⁴ A school could still be "graded" according to annual SOL test performance, if so desired, but such a report card should be interpreted primarily as an indicator of the "academic ability" of the current student body and secondarily as an instructional quality measure (similar to the way athletic teams are perceived each year). It should *not* be the sole accreditation criterion.

those who oppose it. Two “faults” found by opponents have been (1) the vagueness of the “improvement” criterion²⁵ and (2) the abandonment of the 70 percent standard as a worthy goal.²⁶ This second edition addresses these valid concerns.

The 70 percent standard has both positive and negative features. Admittedly, the negative features have been the focus of this report. In the interest of encouraging reconsideration of Recommendation #1 by those initially opposing it, emphasis is redirected here towards the positive aspects of the 70 percent standard that must be captured in any accreditation system based on the “improvement” or “value-added” criterion.

We should measure how much “improvement” has occurred as a result of the 70 percent standard during the first two years of testing (or three, if we wait until this spring’s results are available), and use that as the benchmark for any new standard. Then we will have at least as “tough” a standard against which to measure performance as the current standard provides.

²⁵ In a February 16, 2000 news article in the Hampton Roads *Virginian-Pilot*, Board of Education President Kirk Schroder observed that an “improvement” from 7 percent to 10 percent, for example, would not be an achievement worthy of praise or accreditation, and he is right. The same article, however, included interview comments from the author of this study, who pointed out that under the current system, a school could improve its pass rate from 20 percent to 60 percent and still be denied accreditation. With such a range of illustrations of “improvement,” clarification of that term is necessary.

²⁶ The first edition of this report did call for the elimination of the 70 percent goal. In response, in a February 9, 2000 *Washington Post* article, both Governor Gilmore and Board President Schroder reaffirmed their support of the 70 percent standard, and Mr. Schroder was quoted as saying that he would only consider “improvement” as a criterion if it could be incorporated into a yardstick that maintains the 70 percent standard. In this second edition, we suggest one way that recommendation #1 can be reconciled with keeping the 70 percent mark as a worthy goal.

In other words, use data from our current experience and set benchmark improvement measures that are just as challenging as those achieved under the 70 percent standard. In that way, the “positives” of the current policy could be retained while the “negatives” (falling public support for the standards program) could be eliminated.

Finally, much of the heated debate on this issue has been over the alleged “sole” criterion for accreditation under current policy. An accreditation system with explicit multiple criteria that are internally consistent could provide a solution acceptable to a broad cross section of Virginians. To help steer that debate in a constructive direction, I have outlined a “Four Star School” accreditation system.

Four Star Schools

To gain or retain accreditation, a school would have to meet at least three of the four criteria listed below. The amount of improvement needed to satisfy the first three criteria would be based on three new challenging “improvement benchmarks” that the Board of Education would establish after measuring improvement achieved thus far by the 70 percent standard.²⁷

1. The Inclusion Criterion: Meets the Board’s new benchmark standard for raising the average of the student pass rates on the four tests. The inclusion criterion would be a measure of the scope of the school’s instructional efforts--the extent to which it reaches an entire class of students and not just those already highly motivated to learn.

²⁷ The three improvement benchmarks should compare performance of the same students in different testing years (e.g., 8th vs. 5th grade), rather than comparing performance on the same test (e.g., 8th grade test) for different students. This is necessary for eliminating the spurious effects of class-to-class variation in student ability, and also to avoid the “compression” effect that sets in when improvement percentages begin to level off. It is possible to construct an index to measure cohort improvement that is not affected by the diminishing returns principle.

2. *The Excellence Criterion: Meets the Board's new benchmark standard for raising the average raw score on the four tests.* This would correlate with the first criterion, but would also signal excellent performance by some students.

3. *The Well-Rounded Criterion: Meets the Board's new benchmark standard for raising the percentage of students passing all four tests.* This criterion would stress the importance of a well-rounded education.

4. *The Four Star School.* Any school that meets all three improvement benchmark standards and also reaches the current 70 percent standard would be designated a "Four-Star School." This criterion would retain the current 70 percent standard as one measure of accountability, and would say to parents, college admissions officers, and employers: This is a superior school.

Student Accountability Policy

Current SOA policy also requires secondary students to pass end-of-course SOL tests to earn certain graduation credits, beginning with the Class of 2004. That policy has not been critiqued thus far in this report, primarily because it can be addressed without complex analysis. It is not unreasonable to expect students to pass end-of-course SOL tests in order to receive graduation credits for courses in which they have enrolled. If properly constructed to assess what students were supposed to gain from the SOLs for a particular course, such tests should be no more difficult than a teacher-made final exam. However, the timetable for holding students accountable should be amended to reflect the fact that the seniors in 2007 will be the first class with twelve years of SOL instruction.

RECOMMENDATION 2. Amend the SOAs so that end-of-course SOL test requirements apply initially to students in the graduating class of 2007, and to each class thereafter.

CONCLUSION

Accountability is imperative when a policy is not self-executing. Designing an accountability standard, however, requires utmost attention to the incentives it sets in motion. It must highlight the right indicators, and it must enhance the effectiveness of policy implementation.

A value-added approach to accountability would restore the SOL principle of cumulative learning growth. Moreover, with the focus on strengthening class cohorts, the key "expectation" would be for test score improvements. There would be none of the adverse side effects resulting from comparisons with unrealistic targets. Teachers and students could tackle the SOLs in a spirit of discovery rather than an aura of anxiety.

Those committed to the purpose of the 1995 SOL program--rigorous *learning* standards leading to higher levels of academic achievement by Virginia's students--should endorse amending a 1997 *accreditation* standard that threatens to undermine the fundamental reform it was intended to support.

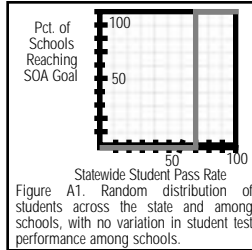
Hopefully, this second edition of the report is responsive to the concerns of those who share the author's commitment to strong learning and accountability standards and want to keep the best features of the current accreditation system.

Appendix A

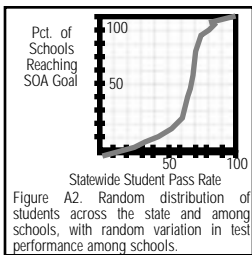
Pass Rate Growth Methodology

Derivation of the pass rate growth curves in Figures D (page 3) and 12 (page 17) required successive comparisons of curves based on different assumptions about the variance in student test performance from one school to another, plus a non-linear regression analysis and computer simulation of actual 1998 and 1999 results.

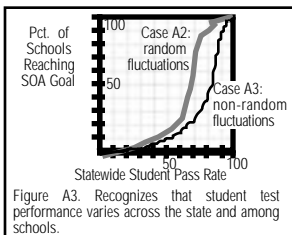
Alternative Assumptions Regarding Variation in Student Test Performance



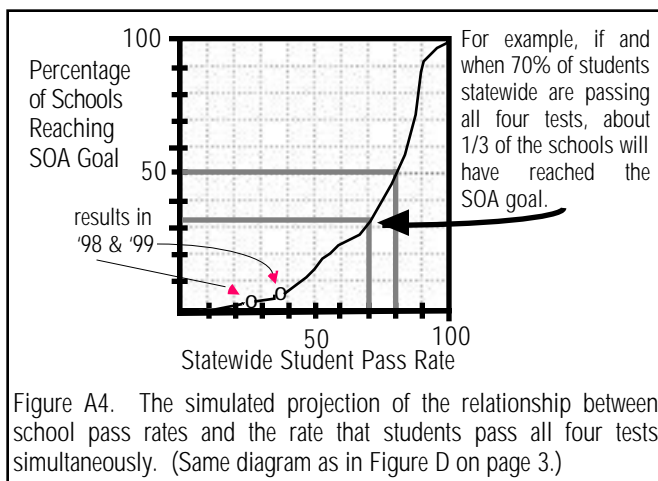
Case A1. No Variation. This assumption is that students are distributed randomly across the state and among schools, with no difference in their ability to pass the SOL tests. This leads to a projection that all schools will reach the 70% goal in the same year. Thus the "curve" in Figure A1 is a straight line along the horizontal axis (i.e., "zero schools passing") that turns vertical at the point where 70% of the students pass the four tests statewide. The vertical line goes to 100%, meaning that all schools pass at the same time.



Case A2. Only Random Variation. Although still assuming random distribution of students, this assumption admits that there will be random fluctuations in test scores from school to school even as all schools move toward the 70% goal. Some schools will get there sooner and others later than the average school, which will get there when statewide student pass rates are 70%. This produces a non-linear curve similar in shape to Figures D and 12 in the report, but it slopes upward much sooner. It predicts that 70% of the schools will achieve the SOA goal when 70% of the students statewide are passing the four tests.



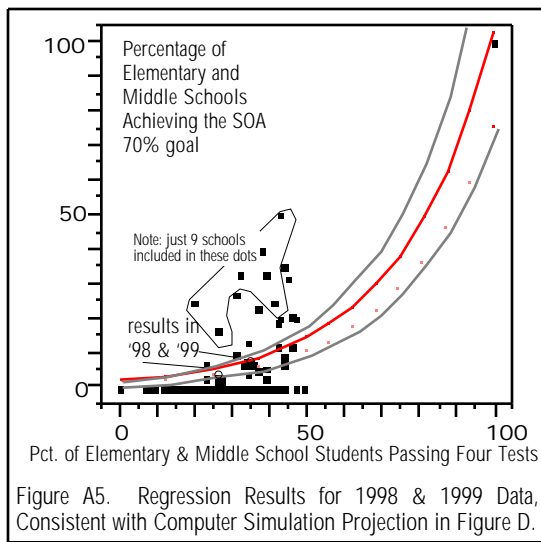
Case A3. Test Score Variation that is Not Random. This view recognizes that students are not randomly distributed among schools. In both 1998 and 1999, 66% of the schools reaching the SOA goal were located in three school divisions having just 16% of the schools in the state. Given that those three school divisions are accounting for a big fraction of the increase in "accredited schools" until just about all of their schools are accredited, the increase in student pass rates will not generate as many newly accredited schools as quickly as Figure A2 predicts, since many of the schools in those divisions will exceed the 70% mark. This makes the curve extend further to the right before it curves upward steeply, as shown by the solid line in Figure A3.



schools meeting the 70% goal was 2.2% and 6.5%. The curve in Figure A4 was derived by a computer simulation model that incorporated the Case A3 assumption (i.e., variation in student performance non-randomly distributed among schools), 1998 and 1999 statewide and school division data, and the estimated percentage of students passing all four tests. The curve in Figure A4 differs from the solid line in Figure A3 between the 40% and 70% student pass rate marks on the horizontal axis, where the curve changes direction. That is the range in the computer simulation run when the schools in the three high-achievement divisions completed their achievement of the SOA goal. That pushed the curve to the right, where it resumed a growth pattern similar to that shown in Figure A3. Subsequent non-linear regression analysis generated a similar curve, shown in Figure A5 on the next page.

Individual Student Goal vs. Individual School Goal

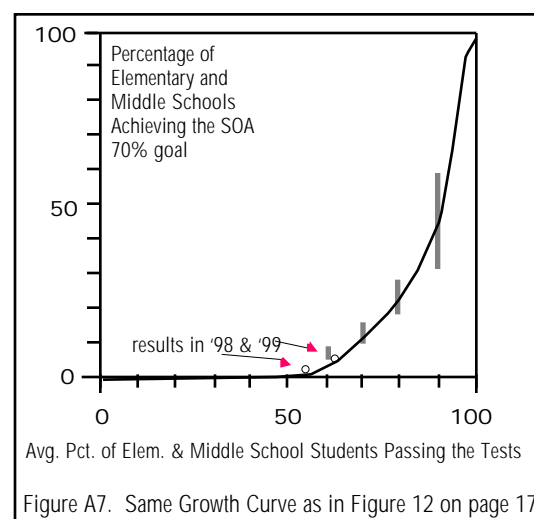
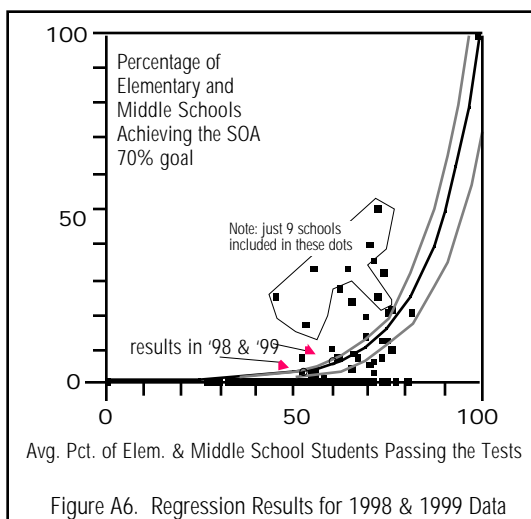
The implicit goal for each student is to pass all four tests. The percentage of students reaching that goal was estimated by taking the probability of passing the test with the lowest pass rate (history: 40% and 50% in 1998 and 1999), and then determining the joint probability of passing all four tests. Analysis of scores showed history test result correlations of .77, .81, and .83 with results on math, science, and English tests. Thus, high conditional probabilities were assumed for passing math (.80), science (.90), and English (.95) tests, *given* that a student had passed the history test. The joint probability calculation estimated the percentage of students passing all four tests in 1998 and 1999 to be 25% and 35%. In those same years, the percentage of



Validation of Figure D (page 3). In Figure A5, each dot represents a school division's elementary and middle schools (which account for nearly 85% of all schools in Virginia, and 90% of the schools reaching the SOA goal). At each extreme point (0% and 100%), the dot is weighted by the total number of school divisions (i.e., all school divisions would have 100% of their schools passing when their average student pass rate reached 100%, and conversely with 0%). Between the extremes, the dots show the actual 1998 and 1999 results of SOL testing at the school division level, and the two hollow circles (not part of the regression model) represent the actual statewide results. What appears to be a solid straight line ranging from about 10% to 45% on the horizontal axis is actually dozens of school division dots bunched together. The solid upward sloping curve is the "best fit" regression line, based on a non-linear (exponential) model, weighted by the number of schools in each division. Thus, dots representing divisions with larger numbers of schools have more influence on the shape of the curve, an

important point to remember since many of the dots above the curve "that are easy to see" contain just one school and exert little influence on the shape of the regression line (see notes on the graphs). The dashed curves on both sides are the 95% confidence limits. Inspection of the curve in Figure D on page 3 reveals that it is always within the upper and lower confidence limits of the regression results in Figure A5, even though the two projections were derived by entirely different, independent methodologies. That helps confirm the validity of the Figure D projections.

Development of Figure 12 (page 17). In Figure A6 below, the same data that generated the curves in Figures A5 were used in another weighted, exponential regression analysis. Note that the shape of the solid regression line and the confidence limits is similar to the shape of the regression results in Figure A5. However, the units on the horizontal axes distinguish the two graphs; in Figure A6 below, the curve is farther to the right. The student pass rate in Figure A5 above refers to the percentage of students meeting their implicit goal of passing all four tests in a given year. Here, however, we are projecting the relationship between average student pass rates (e.g., 80% passing English, 70% passing science, 60% passing math, and 50% passing history would yield an average of 65%). Derivation of Figure A7, which is the same as Figure 12 on page 17, requires balancing two criteria: staying within the 95% confidence limits below and remaining consistent with the projections in Figure A5 above. Consistency requires recalling that the two measures of student pass rate are the result of different calculations but based on the same data. It also requires awareness that the conditional probabilities used to estimate the percentage of students passing all four tests in 1999 will move toward 1.0 as the average pass rate rises toward 100%. Given these consistency requirements, the dashed vertical lines were calculated as upper and lower limits that would be consistent with both Figures A5 and A6. And, of course, the curve should begin at 0%, end at 100%, intersect the actual 1998 and 1999 results, and maintain a smooth trajectory in keeping with the underlying exponential growth until leveling off as it approaches the 100% mark. Given these constraints, the resulting curve in Figure A7 was drawn, which is the same as Figure 12 on page 17.



Appendix B

Virginia

Standards of Learning Assessments
Statewide Passing Rates
 Spring 1998 and Spring 1999

SOL Test	1998 Passing Rate (%)	1999 Passing Rate (%)	Change from 1998 to 1999
Grade 3			
English	53	61	+ 8
Mathematics	63	68	+ 5
History & Social Science	49	62	+13
Science	63	68	+ 5
Grade 5			
English: Reading, Literature, & Research	68	69	+ 1
English: Writing	65	81	+16
Mathematics	47	51	+ 4
History & Social Science	33	46	+13
Science	59	67	+ 8
Computer/Technology	72	81	+ 9
Grade 8			
English: Reading, Literature, & Research	64	67	+ 3
English: Writing	67	70	+ 3
Mathematics	53	60	+ 7
History & Social Science	35	40	+ 5
Science	71	78	+ 7
Computer/Technology	63	72	+ 9
High School			
English: Reading, Literature, & Research	72	75	+ 3
English: Writing	71	81	+10
Algebra I	40	56	+16
Algebra II	31	51	+20
Geometry	52	62	+10
Earth Science	58	65	+ 7
Biology	72	81	+ 9
Chemistry	54	64	+10
World History to 1000 A. D. + World Geography	62	68	+ 6
World History from 1000 A.D. to the Present +World Geography	41	47	+ 6
U. S. History	30	32	+ 2

About the Author

David Wheat, Senior Fellow at the Thomas Jefferson Institute for Public Policy, is a consultant, educator, and writer. He is president of Wheat Resources Inc., a consulting firm established in 1981 that specializes in helping clients solve problems and choose strategies through the application of systems thinking and computer simulation. He also coaches teachers in the use of systemic learning skills in the classroom. His political science students practice those skills at Virginia Western Community College, where he is an adjunct faculty member.

His consulting work is enhanced by several years of nationally recognized classroom instruction experience in Virginia, during which time 70 percent of his Advanced Placement Government students scored high enough on national exams to earn college credit, compared to 30 percent nationwide. While a public school teacher, he served on the Governor's Commission on Champion Schools, where he participated in the upgrading of the history and government SOLs for Virginia's students.

He received his Master's Degree in Public Policy from Harvard University's Kennedy School of Government in 1972, and then served at the White House as Staff Assistant to the President, specializing in economic and energy issues. Later, he was an adjunct instructor in public policy at the University of Houston, where he also served as Director of Federal Relations. He is a member of the Association for Supervision and Curriculum Development, the System Dynamics Society, and the Creative Learning Exchange.

Other reports he has prepared for the Jefferson Institute include:

- *Y2K Priorities for K-12* (October 1999)
- *Deficient Diplomas: Is It Time for A Graduate Warranty Program?* (September 1998)
- *Local Perspective in a State Office: The Legislator's Dilemma* (March 1998)
- *Raising Student Attendance: Some Low Cost Strategies* (March 1998)
- *Car Tax Cuts: How Should Localities be Reimbursed?* (February 1998)
- *2000 New Teachers: Where Are They Needed Most?* (February 1998)
- *Understanding Virginia's Report Card: Why Standardized Test Scores Vary from One Community to Another* (November 1997)

Copies of each are available from the Jefferson Institute (703-440-9447) or from the author (540-966-5939). Copies are also available for downloading at <http://www.thomasjeffersoninst.org> and at <http://www.wheatresources.com>.