

Student Achievement

Written by Wayne Patty

1. Provide a brief description of the context of your LSC as it relates to your topic area.

Our LSC involved three organizations: Virginia Tech (a comprehensive land-grant university), Albemarle County Public Schools, and Montgomery County Public Schools. The participating schools are all schools in these two districts that teach any combination of grades K-5, and the subject area is mathematics. As Virginia's largest university with 25,600 students and one of the top 50 research institutions in the nation, Virginia Tech is rooted in its land-grant missions of instruction, research, and solving the problems of society through public service and outreach activities.

Albemarle County is the fifth largest county in Virginia by geographical area. It encompasses 726 square miles in the Northern Blue Ridge and Northern Piedmont of Virginia. At the center of the County is the independent city of Charlottesville (the home of the University of Virginia), and Charlottesville City Public Schools is a separate school district. Albemarle County Public Schools serves approximately 13,100 students in sixteen K-5 schools, five 6-8 schools, and four 9-12 schools. The Albemarle County School Board adopted Investigations in Number, Data, and Space as the mathematics instructional materials in grades K-5 with the understanding that the LSC would provide professional development for the K-5 teachers as they implemented this instructional material.

Montgomery County is located in the southwestern part of Virginia in the region known as the New River Valley and lies in the picturesque area between the Appalachian Plateau and the Blue Ridge Mountains. The district serves approximately 9,300 students in one K-2 school, one 3-5 school, ten K-5 schools, four 6-8 schools, and four 9-12 schools. Montgomery County benefits from having two local universities – Virginia Tech and Radford University. The Montgomery County School Board adopted Everyday Mathematics as the mathematics instructional materials in grades K-5 with the understanding that the LSC would provide professional development for the K-5 teachers as they implemented this instructional material.

The key personnel are Wayne Patty, PI and Project Director, Jesse (Jay) Wilkins, co-PI, Marlene Robinson, and Betti Kreye. Wayne was promoted through the ranks as a research mathematician, served as Head of the Mathematics Department at Virginia Tech for twenty-four years, and served as the PI on a grant from the State Council of Higher Education (as part of Virginia's statewide systemic initiative) to improve the grades 9-14 math and science curricula, and served as PI on a previous LSC for grades 6-12 mathematics. Jay is a research

elementary mathematics educator who was involved in providing professional development for the 6-12 LSC. Marlene is the K-12 Mathematics Instructional Coordinator in Albemarle County Public Schools, and she was a professional development provider for the implementation of two middle school instructional materials: Connected Mathematics and MathScape: Seeing and Thinking Mathematically. (Albemarle County had previously implemented the latter with professional development provided by the 6-12 LSC.) Prior to her position in Albemarle County, Marlene was a middle school mathematics teacher in the Chicago area. Betti is the Mathematic Supervisor K-12 for Montgomery County. She was a mathematics instructor at Virginia Tech prior to joining Montgomery County as a high school mathematics teacher. She served as a professional development provider for the implementation of Contemporary Mathematics in Context, a high school curriculum, and Connected Mathematics.)Montgomery County had previously implemented the latter with professional development provided by the 6-12 LSC.)

2. Provide a brief description of the aspects of the LSC that the project hoped would lead to impacts in student achievement.

We felt that all aspects of the LSC would impact student achievement. First, the simple fact that the teachers would participate in 130 hours of professional development in mathematics should lead to an improvement in teaching. Second, all the professional development would be built around the NCTM-Standards-based curriculum that the teachers would teach. Moreover experienced teachers of the curricula would be walking the teachers through the units so they would know how it was supposed to be taught. Third, we would provide mathematics content sessions designed to increase the teachers' content knowledge well beyond the mathematics they would be teaching. Fourth, the teachers would have 60 hours of professional development as described above before they walked into a classroom to teach the curriculum. Fifth, we would be meeting with the teachers in two 3-hour sessions each month during the first year of implementation. This would provide an opportunity to continue the same type of training, but also it would provide an opportunity to address, in a timely manner, any issues that arose in their classroom regarding the curriculum itself, the manner in which a given unit should be taught, and the mathematical content. Finally, the follow-up sessions after the first year of implementation would allow us to continue what we had been doing, would allow the teachers to reflect on what they had done and changes that should be made, and would continue the opportunity to address issues that arose in the classroom.

3. What evidence is there that the LSC did or did not have an impact on student achievement?

Virginia has adopted statewide Standards of Learning (SOLs) and SOL tests in mathematics at the elementary level are administered near the ends of grades 3 and 5. These SOL tests are strictly multiple choice tests so we felt that they were

lacking in being able to measure conceptual knowledge and problem solving skills. Albemarle County expressed the desire to administer the New Standards Reference Exam (NSRE) in mathematics near the end of grade 4. Moreover, Jay Wilkins (co-PI) designed a survey to measure change in Fourth Graders' Beliefs and Attitudes toward Mathematics. The NSRE and Jay's survey has been given to fourth graders each year in Albemarle County beginning in the Spring of 2002. The 2002 results were base-line data because the fourth graders in 2002, designated Cohort 1, had not been exposed to Investigations in Number, Data, and Space. The fourth graders in 2003, designated Cohort 2, had two years of exposure to the curriculum, and the fourth graders in 2004, designated Cohort 3, had four years of exposure to the curriculum. We do not have the data from Harcourt for the fourth graders in 2005 so this group will be included in a later study. This group will be designated as Cohort 4, and they have been exposed to the curriculum for all five years of their formal education. Thus our current report is restricted to Cohorts 1, 2, and 3. Our general findings regarding the NSRE are:

- The relationship between cohort and the percentage of students meeting the standard for problem solving was found to be statistically significant suggesting that on average, increased use of Investigations in Number, Data, and Space was related to increased levels of problem solving skills.
- The relationship between cohort and the percentage of students meeting the standard for conceptual knowledge was found to be statistically significant suggesting that, on average, increased use of Investigations in Number, Data, and Space was related to increased levels of conceptual knowledge.
- Although the percentage of students reaching the standards for the skills component did increase across the cohorts, the relationship between cohort and the percentage of students meeting the standard was not found to be statistically significant.

The survey regarding beliefs and attitude toward mathematics was designed to measure enjoyment, self-concept, math as memorization, and math and society. Our general findings regarding these beliefs and attitudes are:

- **Enjoyment:** On average, the difference in mean scores between Cohort 1 and Cohort 3 was found to be statistically significant suggesting an increase in enjoyment.
- **Self-Concept:** No statistically significant difference by cohort.
- **Math as Memorization:** On average, the difference in mean scores between Cohort 1 and Cohort 2 and between Cohort 1 and Cohort 3 were found to be statistically significant indicating a decrease in the belief that math is mostly memorizing.
- **Math and Society:** On average, the difference in mean scores between Cohort 1 and Cohort 2 was found to be statistically significant suggesting an increase in the believe in the importance of math in society. The average for Cohort 3 is slightly smaller than Cohort 2, and even though it is only slightly smaller, it is enough to make it not statistically significant from Cohort 1.

At this point, only SOL data through school year 2003-2003 is available to the public. The adopted curricula were implemented in the third grade in both Albemarle and Montgomery Counties during the 2001-02 school year so the third grade students who took the SOL test in the Spring of 2002 had used the curriculum for one year whereas the third grade students who took the SOL test in the prior years had not used the curriculum. The third grade students in both counties who took the SOL test in the Spring of 2003 had used the curriculum for three years. The following table lists the pass rates for four years for both counties and for the state as a whole.

	99-00	00-01	01-02	02-03
Albemarle	77.8	77.1	82.0	84.8
Montgomery	68.6	70.3	74.1	76.0
State	71.3	77.1	80.4	83.0

The adopted curriculum was implemented in the fifth grade in Albemarle County during the 02-03 school year so the fifth grade students who took the SOL test in the Spring of 2003 had used the curriculum for one year whereas the fifth grade students who took the SOL test in prior years had not used the curriculum. The adopted curriculum was implemented in the fifth grade in Montgomery County during the 01-02 school year so the fifth grade students who took the SOL test in the Spring of 2002 had used the curriculum for one year and those who took the test in the Spring of 2003 had used the curriculum for two years. The fifth grade students who took the SOL test in prior years had not used the curriculum. The following table lists the pass rate for four years for both counties and for the state as a whole.

	99-00	00-01	01-02	02-03
Albemarle	70.6	70.4	78.3	78.0
Montgomery	56.9	57.9	60.2	63.0
State	63.3	66.6	71.1	73.5

In summary, the average SOL passing rates in both divisions continued to increase after the implementation of the standard-based curricula, and in some cases the increase was greater than the overall rate for the state. The lack of an extreme increase is not surprising and is consistent with other findings from the project. The SOL tests have been cited for an emphasis on measuring computation skills. Given this, these findings are consistent with those found for the skills component of the New Standards Reference Exam. Findings from the NSRE also found only small increases in skills based knowledge. The SOL tests

may not be sensitive to changes in students' conceptual or problem-solving knowledge which are emphasized in the standards-based curricula.

4. What aspects of the LSC do you believe were most responsible for these impacts and why?

We believe that all the expectations listed in response to Question 2 were important and that together they resulted in an improved atmosphere in the classroom and teachers who understood the mathematics and how to teach it. The bottom line is that kids loved it. Math was fun! It was no longer a dull subject that was to be memorized without understanding.