Analytic memo for Horizon Research, Inc.

K-5 Inquiry-Based Science Program, a Local Systemic Change Grant

EIS-9554605 Hands-On Science in Seattle Public Schools

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Evidence of the LSC's Impact on Student Achievement

Seattle's scientists, educators, and parents applied for the Local Systemic Change Grant (LSC) from the National Science Foundation with the purpose of raising student achievement in science. World renown, Dr. Leroy Hood and Valerie Logan Hood, his wife, led the stakeholders in the effort by organizing some very strong partnerships among university departments, Boeing, and the Seattle Public Schools.

The Seattle School District is urban and multi-ethnic. There are approximately 1000 K-5 classroom teachers and 21,874 students in 70 elementary schools. Approximately 41% of the student population is on free or reduced lunch, and approximately 58% of the 46,416 K-12 students are ethnic minorities. Community activism and stewardship contribute to a very unusually supportive relationship between the school system and the community. The School Board and leaders of the district encourage the development of community partnerships to enhance student achievement and close the gap.

In the first few years of the LSC, a number of courses were developed. Through teacher feedback, classroom observations, and study of recent research, project staff has continually adjusted the courses. The main courses that we continue to offer are:

Initial Use - Participants learn about the components of good standards-based science instruction: the conceptual story of the unit; pedagogy of inquiry-based science including the use of the learning cycle; philosophy; lessons; management of the unit, materials, and students; state standards connections, and assessment.

Science Content Courses: - Participants strengthen skills to facilitate an inquiry-based, science rich classroom necessary to bring students to higher standards of understanding; uncover difficulties and/or counterintuitive knowledge inherent in the student lessons; collaborate with science experts and teacher colleagues, and participate in their own investigations related to the science concepts from the specific science unit.

Expository Writing and Science Notebooks Classes: The introductory sessions offer strategies for helping students to: draw scientific illustrations with captions; describe observations (descriptive or observational writing), including compare/contract and cause/effect; record data in tables; creating and interpreting graphs (statistics/data analysis); develop paragraphs that explain conceptual understanding, including providing qualitative and quantitative data as evidence for thinking (summative writing). In the grade level sessions, the instructor often models a mini-lesson and then guides teachers in the practice of looking at student work. This instructor models offering suggestions for feedback to students and adjustments to future lessons. Participants give input in this process.

The project staff offered more classes earlier during the first six years of the LSC which they can no longer provide, at least on a regular basis, because of lack of funds and staffing capacity: Subtle Shifts (Inquiry), Lesson Study, and Data Analysis. The 24-hour Data Analysis class is unusual in that it is taught by a world renowned statistical geneticist and two of her colleagues. Participants are introduced to the foundations of statistics, learn from their own generated data, learn which types of graphs to use in different situations, and learn how to organize and display data.

The Science Resource Teachers (SRTs) working on the project, were released from the classroom 100% of the time. With the support of the Project Director, they focused on continually strengthening the courses such that teachers would improve instruction allowing students to achieve at higher levels. In the first five years of the project, the SRTs averaged 82 hours per year of their own professional development. The staff took every opportunity to strengthen their own skills so that they could serve the teachers better. Through this work, the goal was to raise student achievement.

In these past nine years since the LSC began, fifth grade students have been assessed with the Iowa Test of Basic Skills (ITBS), the Partnership for the Assessment of Standards-Based Science (PASS), and just last year, the Washington Assessment of Student Learning (WASL). Below are the results. In each case, the professional development and curriculum materials support for teachers appear to have made a positive impact on student achievement in inquiry science.

For the duration of the LSC, spring 1997 through spring 2003, 5th grade students took the ITBS science test. In the first few years, the ITBS scores went up, but once a district-wide literacy initiative was started in 2000, the scores started to drop. Later they went back up slightly. WESTAT researchers in Rockville, Maryland analyzed the scores and published a report in December 2003. They assessed the impact of the professional development on student achievement, measured by 5th graders' science performance on the ITBS. They reported the following:

To what extent have schools and teachers participated in the project?
After being piloted in two schools in 1995–96, the project grew gradually over the years. By 2000–2001, all of the city's 68 elementary schools were participating in the project. Teachers have received, on average, 61 hours of professional development training. By 2003, 52 percent of all current elementary teachers received 60 hours or less of training, 42 percent received 61 to 120 hours, and 6 percent received 121 hours or more. The amount of professional development for 5th grade science teachers is slightly higher, with 45 percent receiving 60 hours or less of training, 44 percent receiving 61 to 120 hours, and 11 percent receiving 121 hours or more.

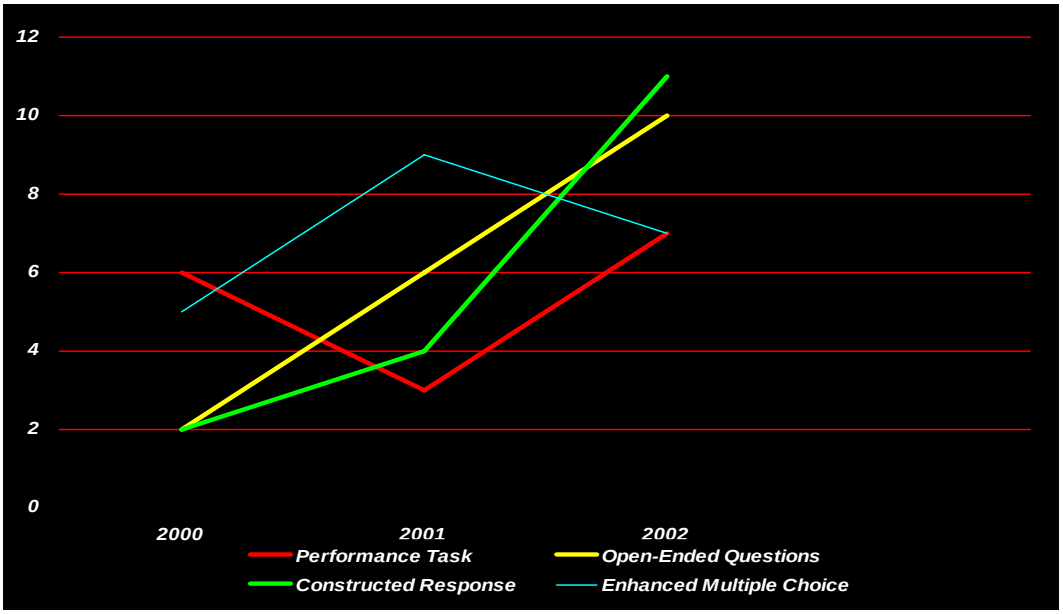
How does the amount of professional development received by teachers contribute to student performance in science? The amount of teacher professional development has a small but significantly positive effect on student achievement in science (effect size=.01). Specifically, if a teacher receives 100 hours of professional development, his/her students will score, on average, 4 more points on the ITBS science test. However, without further information about how teachers implement what they have learned in classroom, it is difficult to achieve a full understanding of the project effect.

An Evaluation of the Impact of Hands-On Science in Seattle Public Schools on Student Learning, Xiaodong Zhang and Lawrence Wang, December 2003

In the school years 2000, 2001, and 2002, approximately 10% of the 5th grade students took the PASS assessment developed at WestEd in San Francisco, California. This assessment was developed for districts with large reform efforts in place. Teachers volunteered to participate, but the staff was able to get a diverse group of volunteers. The percentage of free and reduced lunch ranged from approx. 15% to 86%. Some schools had just joined the project, while others had been in the project since the first or second year. Some of the teachers were master teachers while others were more in the average and even low-average range in terms of their instructional skills.

In the first year, 225 Seattle 5th graders took the test; in the second year, 368 Seattle 5th graders took the test; and in the third year 216 Seattle 5th graders took the test. There are approximately 2800 5th grade students in Seattle Public Schools. The 5th grade students of four schools took the PASS assessments in each of the three years. Please see the line graph below which shows that the district average is above the national average by 2 - 11%. (The y-axis shows the percentage above the national average.) Kathy Comfort, the developer of the PASS Assessments at WESTED in San Francisco, said in a telephone conversation, *These scores are significant, there is a pattern, you have a model, and you must share it*.

District Average Over the National Average on the Partnership for the Assessment of Standards-Based Science (PASS).



The green and yellow lines (Constructed Response and Open-Ended Questions respectively) show a dramatic rise. These are the most difficult items as they require writing. This may show the impact of the Expository Writing and Science Notebooks component of the program.

All Seattle Public Schools' 5th grade students were required to participate in the last pilot of the state assessment in May 2004 before it became mandatory this year (2005). **Seattle's 5th graders scored above the state average on each scored category**: properties of systems, structure of systems, changes in systems, inquiry in science, and designing solutions. The first state mandated science assessment was given in May 2005. Those scores will be available in September 2005. The Outreach staff at the Institute for Systems Biology compared Seattle's 2004 scores with 5th grade scores in other districts in the state as shown below:

Seattle's 5th Grade Science Pilot WASL Results

- Seattle's 5th graders scored in the top 22% of all districts in Washington State (54/239).

- The 53 districts that scored higher than Seattle were small districts or had students living in less poverty.
  - —For districts with an equal or greater poverty rating, Seattle scored in the top 10% (11th of 111 districts).
  - —The small districts tested between 11-217 5th grade students, while Seattle tested more than 3500 5th grade students.

- When disaggregating data for large districts (testing more than 1000 5th grade students)
  - —Seattle outscored every district testing more than 2000 5th grade students.
  - —Seattle scored 8th of 21 districts testing more than 1000 5th grade students.
  - —The 7 districts scoring higher than Seattle (poverty rating of 41) all had lower poverty ratings (average 20.1).

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In each of these three assessments there are problems that keep the results from being conclusive. The ITBS test is not standards-based. Only a very small group of 5th graders took the PASS assessments and their teachers volunteered. The WASL is new and needs to undergo refinement, and teachers need to learn how to better prepare their students for it. In addition to this, we are not sure of the fidelity of implementation of the units. We know there are "pockets" in the schools where the science units are taught extremely well and other "pockets" where the units are not taught well. Nonetheless, in each of these assessments, there are positive results.

The feedback from teachers gives us other information. They have stated that the Initial Use classes help them get started with their instruction with the units. But, it is the strategies provided in the Expository Writing and Science Notebooks classes that help them refine their instruction. The greatest synergy in the program right now is the integration of and feedback loop between the Initial Use classes and the Expository Writing and Science Notebooks classes. These two classes are the true legacy of our Local Systemic Change Initiative work.

The Inverness Research Associates of Inverness, California have researched the Science Notebooks Program for the past five years. Through a teacher survey and review of the notebooks by master teachers and outside science and writing experts, Inverness found the following:

The Seattle *Expository Writing and Science Notebooks* program is specific and explicit in its approach and can serve as a model for other districts that wish to establish similar links between science and writing. The support for teachers is thorough and well delineated, and engineered so that they learn not only how to implement science notebooks but also how to use specific strategies and structures that help elementary students learn to think and write like scientists. Through the *Expository Writing and Science Notebooks* classes and supplementary writing curricula, which build on classes and supplementary curricula about science-unit implementation in the *K-5 Inquiry-Based Science Program*, teachers have increased their ability to teach science as inquiry, focus on science concepts, and assess student learning. (Inverness, 2003) Research also has shown that teachers involved with this science notebooks program in Seattle spend more time teaching science, teach more writing in science, and follow the district's curriculum more consistently than teachers with little or no experience with this approach. (Inverness, 2003) Furthermore, a structured assessment of students' science notebooks carried out by outside experts in science education and writing along with Seattle teachers determined that students showed exceptional progress in understanding science concepts and developing expository writing skills. (Inverness, 2003) Independent experts judge that the student work in science notebooks [from this program] is, on the whole, more sophisticated in quality, and reflective of greater rigor and a higher level of learning of both science and writing, than is typical in science programs in other schools and districts [across the nation] that use similar science units. . . . The writing program thus enhances to a significant degree the district's elementary science program and it helps bolster the district's literacy program, including the extent to which those programs help students meet state standards. (Inverness 2003)

A report is due soon on the impact of 7.5 hours or more in the Expository Writing and Science Notebooks classes on the WASL. The National Center for Research on Evaluation, Standards, and Student Testing (CRESST) at UCLA is doing a detailed analysis and the results so far appear to be promising.

More research needs to be done, but the work of the LSC seems to have made a substantial impact on the achievement of elementary students. The following have contributed to the success:

- The strong vision of the leaders at these levels: CEO, Project Director, SRT, and teacher
- The partners' contributions allowing continuity of staff over a long period of time
- Intensive professional development for the staff
- Collaboration with university scientists and other partners
- Building continually on the five elements defined by the National Science Resources Center: High quality curriculum, on-going professional development, materials support, assessment, and strong administrative and community support
- Taking time to develop strategies and courses (quality, not speed).
- Working with powerful, supportive partners.