NSRC LASER i3 Validation Study
A Systemic and Sustainable Approach for Achieving High Standards in Science Education

Executive Summary
2010-2011 Annual Interim Report

April 2012

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This document represents a brief executive summary of the first annual interim report prepared by the Center for Research in Educational Policy for the NSRC LASER i3 Project, led by Dr. Martha Alberg, Principal Investigator and co-Principal Investigators: Dr. Carolyn Ransford-Kaldon and Dr. Donald (Chip) Morrison. Data collection for this project is ongoing and results reported here are preliminary.

The contents of the annual interim report were developed under a grant from the U.S. Department of Education, Investing in Innovation (i3) Program. However, those contents do not necessarily represent the policy of the U.S. Department of Education, and you should not assume endorsement by the Federal government.

Consolidated Appropriations Act, 2012 (Public Law 112-74)

Acknowledgement of Federal Funding (Section 505):

When issuing statements, press releases, requests for proposals, bid solicitations and other documents describing projects or programs funded in whole or in part with Federal money, all grantees receiving Federal funds included in this Act, including but not limited to State and local governments and recipients of Federal research grants, shall clearly state —

1. the percentage of the total costs of the program or project which will be financed with Federal money – 80%;

2. the dollar amount of Federal funds for the project or program – $25,536,561; and

3. percentage and dollar amount of the total costs of the project or program that will be financed by non-governmental sources – 20% and $5,107,312.
Introduction

In August 2011, the National Science Resources Center (NSRC), a division of the Smithsonian Institution, received a grant of more than $30 million from the U.S. Department of Education’s Investing in Innovation (i3) program for a five-year study to validate its Leadership Assistance for Science Education Reform (LASER) model in three regions: rural North Carolina, northern New Mexico, and the Houston Independent School District (HISD). The independent third-party research evaluation of this five-year validation study is being conducted by the Center for Research in Educational Policy (CREP) with technical assistance from Westat and Abt Associates, who have been provided to i3 grantees’ evaluation partners by the US Department of Education (USDOE). This report summarizes the October 2010-September 2011 accomplishments of CREP related to preparation for the implementation of the LASER model in participating schools.

CREP, a Tennessee Center of Excellence, is a research and evaluation unit based at the College of Education, Health and Human Sciences, University of Memphis. The Center’s mission is to implement a research agenda associated with educational policies and practices in preK-12 public schools and to provide a knowledge base for use by educational practitioners and policymakers. Since 1989, the Center has served as a mechanism for mobilizing community and university resources to address educational problems and to meet the University’s commitment to primary and secondary schools. Functioning as a part of the College, the Center seeks to accomplish its mission through a series of investigations conducted by Center personnel, college and university faculty, and graduate students.

The following sections provide high-level summaries of previous research, primary research questions, data collection methods, and preliminary findings related to the LASER model.

Previous Research

Previous research has linked inquiry-based science instruction (i.e., science instruction that engages students in doing science rather than just learning about science) with greater gains in student learning than textbook based methods (Banilower, 2007; Bredderman, 1983; Ferguson, 2009; Shymansky, Hedges, & Woodworth, 1990; Vanosdall, Klentschy, Hedges & Weisbaum, 2007). However, while there have been a large number of studies in this domain, only a small number have involved random assignment, and most of these have involved random assignment of students, not schools (see Furtak et al. 2009).

According to its developers and those who have reviewed previous work, LASER has already been successfully implemented in a number of states, impacting tens of thousands of teachers and hundreds of thousands of students (Horizon Research, 2010; RMC Research Corporation, 2010; Vanosdall et al., 2007). However, there have not yet been any experimental studies conducted that support a causal link between program implementation and increased student science learning. The present study therefore has two purposes. The first is to test the hypothesis that the LASER model, as implemented by the NSRC, is capable of producing positive outcomes related to student science learning in multiple and diverse settings, as compared to a control group. A second purpose is to identify for the NSRC and educators everywhere factors that provide support or create barriers to the provision of high-quality science instruction to students.
Research Design and Methods

The NSRC LASER i3 validation study utilizes a matched-pair, randomized controlled trial (RCT) complemented by multiple selected case studies. The matched-pair design is utilized to ensure similarity between groups on both observable and unobservable characteristics. In addition, assessments of fidelity of implementation, including independent observations, attendance records, and feedback from teachers and administrators, are designed to yield both observational data and self-reported survey data. Figure 1 illustrates the selection and random assignment process.

Figure 1.

The case studies will provide a rich, contextualized picture of the experiences of students, teachers, and instructional leaders in a subsample of schools. Research activities conducted during the first year of the NSRC LASER i3 validation study focused on the RCT; case studies will be identified and conducted in subsequent years, based on quantitative and qualitative data collected in the initial phases of the study.

Multiple instruments have been selected or developed during this first year for use in the NSRC LASER i3 validation study. The primary instruments include:

- Partnership for Standards-based Science Assessment (PASS), selected by CREP and developed by WestEd to measure student achievement in science;
- School Observation Measure for Science (SOM-Sci), developed by CREP to record observational data collected by site researchers;
- Science & Technology Concepts (STC) Unit Logs, developed by CREP to record STC implementation data from science teachers in grades 1-8;
LASER surveys, developed by CREP to determine schools’ current status of science instruction and readiness for inquiry-based strategies (completed by district and school administrators as well as science teachers in grades 1-8).

Research Questions

The primary research questions for the study address the relationship between teacher professional development on the STC units, fidelity of implementation of the units (i.e., how the units are taught), and the impact on student learning and student attitudes towards science.

1. Do students in schools that receive the LASER model over 3 years (i.e., Phase 1 schools) attain higher levels of science achievement than students in schools that do not receive the LASER model (i.e., Phase 2 schools) as measured by:
   a. PASS-Basic (multiple choice questions only)?
   b. PASS-Extended (open-ended & performance tasks)?
   c. by state assessments?

2. Do these results vary by subgroup?

3. What factors influence the implementation of the LASER model?
   a. What supports successful implementation?
   b. What barriers are there to successful implementation?

4. What is the impact of participation in the LASER model on student attitudes toward science?

Population

The population from which our study sample is drawn encompasses three regions (Houston Independent School District [HISD], rural North Carolina, and northern New Mexico), and represents a total of 16 districts. This population of school districts includes more than 300,000 students, 20,000 teachers, and over 150 district and building-level instructional leaders.

Sample

Originally, 130 school sites within the three regions were selected to participate in the NSRC LASER i3 validation study and randomly assigned to Phase 1 (immediate implementation) and Phase 2 (delayed implementation). In January 2012, 9 middle schools were added to the HISD sample; therefore, the study initially began with a total of 139 schools, with approximately 2,400 teachers, and 9,000 students. As of April 2012, the study involves a total of 127 schools, with 12 schools no longer participating in data collection or in the entire study for various reasons.

Of these 139 schools, a subset of 86 Phase 1 and Phase 2 schools in each region (i.e., focal schools) was randomly selected to participate in additional components of data collection: 1) the extended version of the PASS assessment which includes open-ended and performance task sections, 2) classroom observations, and 3) school personnel interviews. These focal schools include 32 schools in Houston, 26 schools in New Mexico, and 28 schools in North Carolina. Table 2 illustrates the initial distribution of study sites, including focal schools, in each region by condition.
Table 1. Initial Study Sites by Region and Condition

<table>
<thead>
<tr>
<th>Region</th>
<th>Total</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 1 Focal</th>
<th>Phase 2 Focal</th>
</tr>
</thead>
<tbody>
<tr>
<td>HISD</td>
<td>52</td>
<td>27</td>
<td>25</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>New Mexico</td>
<td>41</td>
<td>21</td>
<td>20</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>North Carolina</td>
<td>46</td>
<td>23</td>
<td>23</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td><strong>Initial Total</strong></td>
<td><strong>139</strong></td>
<td><strong>71</strong></td>
<td><strong>68</strong></td>
<td><strong>44</strong></td>
<td><strong>42</strong></td>
</tr>
<tr>
<td>No longer in study*</td>
<td>12</td>
<td>3</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Current Total</strong></td>
<td><strong>127</strong></td>
<td><strong>68</strong></td>
<td><strong>59</strong></td>
<td><strong>44</strong></td>
<td><strong>42</strong></td>
</tr>
</tbody>
</table>

*Note: 9 of these 12 schools are no longer participating in data collection, but remain a part of the overall study. They are either currently receiving the LASER model (Phase 1) or will receive the LASER model in 2014-15 (Phase 2).

Preliminary Results

LASER Surveys

The LASER surveys were administered in North Carolina in March 2011, and in New Mexico and Houston in September 2011. As may be seen from Table 2, more than 1,200 teacher surveys were completed with an overall return rate of 54%. Preliminary results from the LASER Principal and Teacher Surveys follow.

Table 2. LASER Teacher Survey Return Rates (2011)

<table>
<thead>
<tr>
<th></th>
<th>Phase 1 Schools</th>
<th>Phase 2 Schools</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Science Teachers</td>
<td>Completed surveys</td>
<td>Return rate</td>
</tr>
<tr>
<td>NC</td>
<td>429</td>
<td>341</td>
<td>79%</td>
</tr>
<tr>
<td>NM</td>
<td>260</td>
<td>159</td>
<td>61%</td>
</tr>
<tr>
<td>TX</td>
<td>461</td>
<td>215</td>
<td>47%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,150</strong></td>
<td><strong>715</strong></td>
<td><strong>62%</strong></td>
</tr>
</tbody>
</table>

LASER Principal Survey

A summary of key results from the LASER principal survey indicated that:

- The majority of principals in all three regions indicated that each regular classroom teacher teaches science to his/her class, as opposed to students receiving science taught by a lab teacher or science specialist.
- A small percentage of principals in all three regions stated that science is taught by volunteers or by staff from community-based organizations.
- Among the three regions for the three dimensions: (1) quality science instruction, (2) time spent on science and (3) level of teacher content knowledge, Houston Independent School District (HISD) had the largest percentage of principals indicating significant or substantial variation across classrooms, New Mexico the second largest, and North Carolina the smallest.
- HISD and North Carolina had more than half of principals reporting that it is likely or very likely that a student in the school is receiving high-quality science instruction during school hours, while New Mexico had only one-third.
More than half of principals in all three regions reported that the majority of their students were well-prepared for the next level of science education, with HISD having the largest percentage and New Mexico the smallest percentage.

**LASER Teacher Survey**
A summary of the key results from the LASER teacher survey indicated that:

- In agreement with principals’ responses, the majority of respondents, on average, indicated that students receive science instruction from the classroom teacher (75% in North Carolina, 78% in New Mexico, 72% in HISD).
- Also in agreement with principals’ responses, about 10% of North Carolina teachers, 13% of New Mexico teachers, and 4% or less of HISD teachers indicated, on average, that volunteers or staff from community-based organizations provided science instruction to students.
- On average, at least half of North Carolina teachers (52%), more than a third of HISD teachers (39%), but less than a quarter of New Mexico teachers (15%) use a pacing guide to determine when and what science content to teach.
- Teachers reported that students were most likely to participate daily or at least once per week in reading other (non-textbook) science related materials in class followed by writing reflections, and conducting science investigations in collaboration with other students.
- Teachers most often reported that students never conducted exercises in technological design, followed by never taking internet-based science tutorials, and never participating in field work.
- Teachers felt the most prepared to teach the subject areas of how organisms are adapted to their environment, followed by the characteristic properties of matter, and why some objects float, while others sink in water.
- Teachers felt the least prepared to teach the subject areas of how electric circuits work, followed by how energy drives ocean and atmospheric processes, and the conservation of mass in physical and chemical changes.

**Phase 1 Teacher Questionnaires**

**Level 1 Teacher Content Knowledge: Pre- and Posttests**
A total of 1,033 teachers completed a pretest at the beginning of each 3-day professional development summer training session, and 1,011 teachers completed the post-test at the end of training. Greatest gains were recorded for the Electric Circuits session, with the Butterfly Life Cycle session recording the next-highest gains across all regions. The Forces & Motion session post-test scores reflected the lowest gains, with many posttest scores actually lower than pretest scores across all regions.

**Level 1 Professional Development Summary**
At the conclusion of each 3-day professional development training session, participants were asked to complete the workshop evaluation questionnaire (N=992). The questionnaire consists of 24 Likert-scale items. The first 23 items employed a five-point scale (1=Strongly disagree, 5=Strongly agree), while the final item employed a 10-point scale (1=Among the worst, 10=Among the best).

Ratings were consistently high, with relatively little variance. The overall range on the 5-point scale items was 4.5 to 4.7 across the eight units with Butterfly Life Cycle; Forces & Motion; and Mixtures, and Compounds and Elements receiving a 4.7 rating. Responses to the 10-point scale item comparing these workshops to other professional development sessions were also high, ranging from 8.4 (Electric Circuits, and Motion & Design) to 9.1 (Butterfly Life Cycle; and Mixtures, Compounds and Elements).
Next Steps
Additional interim reports will be forthcoming in the fall of each study year (2012-2014), with a final summative report to be released in 2015. Future reports will also include data analyzed related to the teachers’ implementation of the STC units, student achievement, and student attitudes towards science, in addition to updates for the longitudinal LASER surveys collected each year.

References


