LSC Teacher Interview Study: An Analysis of Data Collected between 1999 and 2003

by

Elizabeth S. Shimkus
Eric R. Banilower

June 2004

Prepared For: The National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

Prepared By: Horizon Research, Inc.
326 Cloister Court
Chapel Hill, NC 27514

Introduction

This study utilizes cross-sectional interview data from teachers who have participated in the LSC projects to date. A series of hierarchical models, with teachers nested in projects, was used to assess the impact of teacher participation in LSC professional development on teachers' attitudes and classroom practices.

Specifically, the perceived impacts of interest in these analyses were:

- Changed views about effective mathematics/science education;
- Increased content preparedness;
- Increased preparedness in the use of designated instructional materials;
- Increased preparedness in instructional strategies;
- Changed classroom practice: what is taught;
- Changed classroom practice: use of designated instructional materials;
- Changed classroom practice: instructional strategies
- Changed classroom practice: assessment
- Changed student outcomes, e.g., attitudes/achievement; and
- Reinforced prior views/classroom practices.

Sample

Between 1999 and 2003, 2,083 teacher interviews were conducted as part of the LSC core evaluation. The eligible sample of interviews was reduced by the removal of data from 301 interviews with teacher leaders, who are not representative of the typical teacher targeted by the LSCs. In addition, 83 interviews were omitted from these analyses due to incomplete data. The final dataset used in these analyses includes cross-sectional data from 1,699 teachers, representing all 76 of the LSC projects active during this time period.[1]

With the exception of their baseline year, regardless of the number of teachers they target, projects are required to conduct interviews with ten randomly selected teachers who have participated in at least twenty hours of professional development each year. Table 1 shows the distribution of teacher interviews in the final data set by targeted subject and grade-range, as well as the number of projects targeting each subject/grade-range.

[1] The one project not represented in these data had been funded only recently; it had teacher interview data from only one year, and all of the interviewees were teacher leaders.

Table 1
Teachers and Projects Included in the Model, by Subject/Grade-Range

Subject/Grade-Range	Number of Projects	Number of Teachers	Percent of Teachers
K–8 Science	36	719	42
K–8 Mathematics	27	470	28
6–12 Mathematics	17	345	20
6–12 Science	7	165	10
Total	**76**[†]	**1,699**	**100**

[†] The sum of projects is greater than the total as some projects target more than one subject/grade-range.

Analysis and Results

Project evaluators coded the LSC teacher interview data to identify teacher-reported impacts of the LSC. Table 2 shows the percent of teachers citing each of the perceived impacts during their interviews. Teachers most commonly mentioned that the LSC had changed the instructional strategies they employ. Other impacts that were mentioned by at least 1 in 4 teachers included increased preparedness to use the LSC-designated instructional materials as well as increased use of those materials in their classroom, and increased preparedness to use various instructional strategies.

Table 2
Perceived Impacts of the LSC

	Percent of Teachers
Changed classroom practice: instructional strategies	49
Changed classroom practice: designated instructional materials used	28
Increased preparedness: instructional strategies	28
Increased preparedness: designated instructional materials	27
Changed views about effective science/mathematics education	21
Changed classroom practice: what is taught	21
Increased preparedness: content	19
Changed student outcomes: attitudes/achievement	13
Reinforced prior views/classroom practice	11
Changed classroom practice: assessment	6

The LSC teacher interview data have a nested structure, with multiple teachers nested within each LSC project. Statistical techniques that do not account for potential shared variance within groups in nested data structures can lead to incorrect estimates of the relationship between independent factors and the outcome. Hierarchical modeling is an appropriate technique for apportioning and predicting variance within and across groups in a nested data structure (Bryk & Raudenbush, 1992).

For each perceived impact, a two-level hierarchical model (teachers nested within projects) was used to investigate the relationship between that impact and the extent of teacher participation in LSC professional development. In addition, a number of school demographic factors were

controlled in these models. As the number of teachers in the data set from any school was small (often only one), it was not appropriate to include the school as a separate level; school data were included at the teacher level. These analyses also controlled for certain project characteristics.

The variables included at the teacher level were:

- Extent of teacher participation in LSC professional development;
- Number of students enrolled in the school;
- Proportion of students in school classified as non-Asian minority;
- Proportion of students in school eligible for free/reduced-price lunch (FRL);
- Proportion of students in school classified as limited-English proficiency (LEP); and
- Type of community in which the school is located.

At the project level, the following predictors were included:

- Number of targeted teachers; and
- Subject/grade-range targeted by the LSC.

Descriptive statistics for the additional teacher, school, and project variables are shown in Tables 3 and 4. There was a great deal of variation in the extent to which teachers had participated in LSC professional development at the time they were interviewed. Forty-two percent of the teachers had participated in 20–59 hours of professional development, with the remainder fairly evenly divided between 60–99 and 100 or more hours. Nearly half of the teachers were from schools located in urban areas, about one-fourth in schools in suburban areas, and the remainder in schools divided between rural locations and towns/small cities.

School sizes varied widely, with the smallest school serving only 5 students and the largest serving nearly 3,000 students. In the average school, 42 percent of the students were classified as non-Asian minority and 11 percent were classified as limited-English proficiency (LEP). On the average, schools had 45 percent of students eligible for free/reduced-price lunch. On average, projects targeted 748 teachers.

Table 3
Descriptive Statistics for Categorical Variables

	Percent of Teachers
Extent of participation in LSC professional development	
20–59 hours	42
60–99 hours	30
100 or more hours	28
Community type in which teacher's school is located	
Rural	14
Town or small city	15
Suburban	25
Urban	47

Table 4
Descriptive Statistics for Continuous Variables

	Minimum	Maximum	Mean	Standard Deviation
Number of students in school	5	2,894	709	422
Percent of students in school classified as non-Asian minority	0	100	42	35
Percent of students in school eligible for free/reduced-price lunch	0	100	45	31
Percent of students in school classified as limited-English-proficient	0	100	11	19
Project size	21	2,052	748	554

Conceptually, each impact was treated as an event with a probability that is related to characteristics of the teacher, school, and project. The analysis produces estimates that can be translated into predicted probabilities that a teacher will report an impact given specific characteristics of the teacher, school, and project.

In technical terms, these outcome variables are dichotomous and were coded for each teacher either 1 (reported the impact) or 0 (did not report the impact). Dichotomous variables have a Bernoulli distribution with:

$$E(Y_{ij}) = \varphi_{ij}$$
$$VAR(Y_{ij}) = \frac{\varphi_{ij}}{1-\varphi_{ij}}$$

where φ_{ij} is the probability that $Y_{ij} = 1$, that is, of a teacher reporting the impact.

A hierarchical generalized linear model was required to model dichotomous outcome variables. A logit link function was used to transform the dichotomous outcome variable for purposes of estimation:

$$\eta_{ij} = \ln\left(\frac{\varphi_{ij}}{1-\varphi_{ij}}\right)$$

Using this transformation, η_{ij} is the logarithm of the predicted odds of a teacher reporting an impact (or "log-odds"). Since the estimated outcome is the log-odds of a reported impact, the predicted probability of reporting an impact for any teacher can be obtained by reversing the transformation using the formula:

$$P(Y_{ij} = 1) = \frac{1}{1+e^{(-\eta_{ij})}}$$

HLM 5.05[2] was used for all analyses. All independent variables were entered using grand-mean centering; categorical variables were entered as sets of dummy-coded variables. The relationship

[2] Raudenbush, Stephen; Bryk, Anthony; Cheong, Yuk F.; Congdon, Richard; Scientific Software International, 2000.

between each of the teacher and school variables and each outcome variable was tested for variation across projects; very few of these were statistically significant and none were consistently significant across outcomes.

One limitation of estimating hierarchical generalized linear models is the inability to use sample design weights. However, the lack of consistent random variation across projects for any of the variables included at the teacher level suggests that the unweighted data provided reasonable estimates, despite the unequal sampling probabilities of teachers in projects of different size. For each impact, the following model was run:

$$\eta_{ij} = B_{0j} + B_{1j}*(\text{School Size}) + B_{2j}*(\text{Non-Asian Minority}) + B_{3j}*(\text{Limited-English-Proficient}) + B_{4j}*(\text{Free/Reduced Price Lunch}) + B_{5j}*(\text{Extent of participation in LSC professional development: 20–59 hours}) + B_{6j}*(\text{Extent of participation in LSC professional development: 100 or more hours}) + B_{7j}*(\text{Community Type: Rural}) + B_{8j}*(\text{Community Type: Suburban}) + B_{9j}*(\text{Community Type: Town or Small City})$$

$$B_{0j} = G_{00} + G_{01}*(\text{K–8 Mathematics}) + G_{02}*(\text{6–12 Mathematics}) + G_{03}*(\text{6–12 Science}) + G_{04}*(\text{Project Size: Small}) + G_{05}*(\text{Project Size: Large}) + U_{0j}$$

$$B_{1j} = G_{10}$$
$$B_{2j} = G_{20}$$
$$B_{3j} = G_{30}$$
$$B_{4j} = G_{40}$$
$$B_{5j} = G_{50}$$
$$B_{6j} = G_{60}$$
$$B_{7j} = G_{70}$$
$$B_{8j} = G_{80}$$
$$B_{9j} = G_{90}$$

The regression coefficients for each model are shown in Table 5. The magnitude and direction of these coefficients should not be interpreted directly. Due to the transformation of the outcome variable and the centering of dummy-coded predictor variables, the coefficients must be converted to probabilities in order to draw meaningful interpretations and conclusions.

Table 5.1
Regression Coefficients and Standard Errors for Each Model

	Reinforced Prior Views/ Classroom Practice	Changed Views of Effective Science/ Mathematics Education	Increased Preparedness: Content	Increased Preparedness: Designated Instructional Materials	Increased Preparedness: Instructional Strategies
Intercept	-2.08***	-1.28***	-1.52***	-1.07***	-0.90***
	(0.09)	(0.11)	(0.09)	(0.12)	(0.11)
Teacher/School Characteristics					
Urbanicity (Urban omitted)					
Rural	-0.18	0.07	0.41	-0.16	-0.05
	(0.30)	(0.27)	(0.25)	(0.26)	(0.25)
Town	-0.13	0.50*	0.08	-0.35	-0.27
	(0.26)	(0.23)	(0.24)	(0.24)	(0.22)
Suburban	-0.24	0.20	-0.16	-0.06	-0.21
	(0.24)	(0.20)	(0.21)	(0.20)	(0.18)
Level of Treatment (60-99 hours omitted)					
20-59 hours	0.09	-0.25	-0.28~	0.03	-0.21
	(0.19)	(0.15)	(0.16)	(0.14)	(0.14)
100 or more hours	-0.10	0.09	0.12	0.06	0.18
	(0.21)	(0.16)	(0.17)	(0.16)	(0.15)
Non-Asian Minority (Transformed)					
	-1.65~	-0.38	0.63	0.58	1.06
	(0.89)	(0.83)	(0.78)	(0.80)	(0.75)
Free or Reduced Lunch (Transformed):					
	-0.30	0.18	-0.17	-0.28	-0.17
	(0.25)	(0.22)	(0.21)	(0.20)	(0.19)
Limited English Proficiency (Transformed):					
	0.18	0.07	0.19	-0.20	-0.16
	(0.27)	(0.23)	(0.22)	(0.22)	(0.21)
Number of Students (Transformed):					
	-0.35	0.10	-0.26	-0.23	0.08
	(0.23)	(0.20)	(0.20)	(0.19)	(0.18)
Project Characteristics					
Project Subject/ Grade Range (K–8 Science omitted)					
K–8 Mathematics	0.33	-0.03	-0.59*	-1.04**	-0.24
	(0.24)	(0.28)	(0.24)	(0.30)	(0.26)
6–12 Mathematics	0.19	-0.09	-0.56~	-1.36**	-0.61~
	(0.32)	(0.38)	(0.33)	(0.41)	(0.36)
6–12 Science	0.05	-0.00	0.51	-0.40	0.09
	(0.40)	(0.49)	(0.39)	(0.51)	(0.46)
Number of Teachers Targeted by the LSC (Transformed)					
+1 standard deviations	0.00	0.02	0.02~	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

~ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 5.2
Regression Coefficients and Standard Errors for Each Model

	Changed Classroom Practice: What is Taught	Changed Classroom Practice: Designated Instructional Materials Used	Changed Classroom Practice: Instructional Strategies	Changed Classroom Practice: Assessment	Changed Student Outcomes: Attitudes/ Achievement
Intercept	-1.36***	-1.02***	-0.03	-2.65***	-1.96***
	(0.09)	(0.10)	(0.08)	(0.17)	(0.12)
Teacher/School Characteristics					
Urbanicity (Urban omitted)					
Rural	0.09	-0.08	0.20	0.28	0.11
	(0.25)	(0.25)	(0.21)	(0.41)	(0.31)
Town	0.17	0.00	0.19	0.10	0.04
	(0.23)	(0.22)	(0.19)	(0.38)	(0.28)
Suburban	0.04	-0.06	-0.06	0.38	0.10
	(0.20)	(0.19)	(0.16)	(0.32)	(0.25)
Level of Treatment (60-99 hours omitted)					
20-59 hours	-0.13	-0.42**	-0.52***	-0.61*	-0.00
	(0.15)	(0.14)	(0.12)	(0.25)	(0.19)
100 or more hours	0.15	0.12	0.21	0.27	0.49*
	(0.17)	(0.15)	(0.14)	(0.25)	(0.20)
Non-Asian Minority (Transformed)					
	0.36	-0.50	-0.51	-0.70	0.78
	(0.78)	(0.76)	(0.64)	(1.32)	(0.94)
Free or Reduced Lunch (Transformed):					
	0.16	0.23	0.33~	0.46	-0.10
	(0.21)	(0.20)	(0.17)	(0.36)	(0.25)
Limited English Proficiency (Transformed):					
	0.21	0.50*	0.10	-0.17	0.25
	(0.22)	(0.21)	(0.18)	(0.37)	(0.26)
Number of Students (Transformed):					
	-0.27	-0.33~	0.05	-0.16	-0.73**
	(0.19)	(0.18)	(0.16)	(0.30)	(0.24)
Project Characteristics					
Project Subject/ Grade Range (K–8 Science omitted)					
K–8 Mathematics	-0.26	-0.93***	-0.12	-0.23	0.15
	(0.24)	(0.24)	(0.20)	(0.43)	(0.30)
6–12 Mathematics	-0.24	-0.59~	0.23	-0.29	-0.80~
	(0.32)	(0.33)	(0.26)	(0.58)	(0.44)
6–12 Science	0.56	-0.06	0.01	0.16	-0.42
	(0.39)	(0.41)	(0.34)	(0.73)	0.55
Number of Teachers Targeted by the LSC (Transformed)					
+1 standard deviations	0.00	0.01	-0.00	-0.00	0.01
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)

~ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 6 provides predicted probabilities for the main variable of interest in this study: participation in LSC professional development. Overall, teachers were most likely to report an impact on instructional materials and strategies, both in terms of their preparedness and classroom use.

It is important to note that all of the teachers participating in the interviews had received at least 20 hours of LSC professional development, and the questions focused on their perceptions of the LSC's impact. Thus, these analyses are most useful for examining the differential impact of various treatment levels. The area in which greater levels of professional development has the most impacts is teachers' classroom practice. Teachers participating in 60–99 hours of LSC professional development were more likely than teachers with 20–59 hours of treatment to report an impact on their use of instructional materials (probabilities of 0.29 and 0.21, respectively), instructional strategies (probabilities of 0.53 and 0.40, respectively), and assessments (probabilities of 0.08 and 0.04, respectively). There were no differences between the 100 or more hours group and the 60–99 hours group in their likelihood of reporting an impact on their preparedness or classroom practices.

In regards to student outcomes, there was difference between the 20–59 hours group and the 60–99 hours group. However, teachers with 100 or more hours of LSC professional development were more likely than those with 60–99 hours of treatment to report impacts on student attitudes and achievements (probabilities of 0.17 and 0.11, respectively).

Table 6
Predicted Probabilities, by Level of Treatment

	Adjusted LSC Average[†]	Level of Treatment		
		20–59 Hours	60–99 Hours[‡]	100 or more hours
Reinforced Prior Views/Classroom Practice	0.11	0.12	0.11	0.10
Changed Views of Effective Science/Mathematics Education	0.22	0.19	0.23	0.25
Increased Preparedness:				
Mathematics/Science Content	0.18	0.15~	0.19	0.21
Designated Instructional Materials	0.25	0.26	0.25	0.26
Instructional Strategies	0.29	0.25	0.30	0.34
Changed Classroom Practice:				
What is Taught	0.20	0.19	0.21	0.23
Designated Instructional Materials Used	0.26	0.21**	0.29	0.32
Instructional Strategies	0.49	0.40***	0.53	0.58
Assessment	0.07	0.04*	0.08	0.10
Changed Student Outcomes: Attitudes/Achievement	0.12	0.11	0.11	0.17*

[†] Values are adjusted for the variables included in the model.
[‡] Referent group.
~ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; significance testing indicates difference from referent group.

Table 7 shows the predicted probabilities of a teacher reporting an impact by project subject/grade-range. Mathematics teachers, both elementary and secondary, are less likely than elementary science teachers to report increased content preparedness in their respective subjects

(probabilities of 0.13 for K–8 mathematics, 0.14 for 6–12 mathematics, and 0.22 for K–8 science), though this difference is likely due to the relatively low levels of initial preparedness elementary teachers typically have in science rather than a measure of the relative effectiveness of mathematics and science projects. Similarly, elementary and secondary mathematics teachers are less likely than elementary science teachers to report an impact on their preparedness to use and actual use of the LSC-designated instructional materials (probabilities of 0.18 for K–8 mathematics, 0.23 for 6–12 mathematics, and 0.35 for K–8 science). Again, this result may be due to the relative infrequency at which science is taught in elementary schools, thus making it easier to enact change in the instructional materials used by elementary science teachers.

Table 7
Predicted Probabilities, by Project Subject/Grade Range

	Adjusted LSC Average[†]	Science		Mathematics	
		K–8[‡]	6–12	K–8	6–12
Reinforced Prior Views/Classroom Practice	0.11	0.10	0.10	0.13	0.12
Changed Views of Effective Science/Mathematics Education	0.22	0.22	0.22	0.22	0.21
Increased Preparedness:					
Mathematics/Science Content	0.18	0.22	0.13	0.13*	0.14~
Designated Instructional Materials	0.25	0.39	0.34	0.18**	0.14**
Instructional Strategies	0.29	0.33	0.26	0.28	0.21~
Changed Classroom Practice:					
What is Taught	0.20	0.22	0.14	0.18	0.18
Designated Instructional Materials Used	0.26	0.35	0.31	0.18***	0.23~
Instructional Strategies	0.49	0.49	0.51	0.46	0.55
Assessment	0.07	0.07	0.06	0.06	0.06
Changed Student Outcomes: Attitudes/Achievement	0.12	0.14	0.14	0.16	0.07~

[†] Values are adjusted for the variables included in the model.
[‡] Referent group.
~ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; significance testing indicates difference from referent group.

Conclusions

Looking across the different impacts, there are two key findings. First, teachers who have participated in a moderate to high number of LSC professional development hours tend to report impacts on their classroom practices more frequently than teachers with fewer contact hours. These impacts include changed practice due to use of designated instructional materials, changes in instructional strategies, and changes in classroom assessment practices. It is somewhat puzzling, however, that teachers with the highest numbers of contact hours were not more likely than teachers with low numbers of contact hours to report these same impacts. It may be that teachers are most likely to report impacts when they are first aware of them, and less likely to do so as such impacts become more commonplace in their classrooms.

Teachers with the highest level of contact hours were more likely than those with a low number of contact hours to report an impact on student outcomes, such as attitudes and achievement.

This finding suggests that teachers who have reached or are approaching the amount of professional development the LSC program requires may more frequently see impacts on their students than teachers who have not yet participated in the LSC to the same extent.

Second, project type appears to be related to teachers' reporting of some impacts of the LSC. Teachers in K–8 and 6–12 mathematics projects were less likely than teachers in K–8 science projects to report impacts in a number of areas. In each of three areas, content preparedness, preparedness to use designated instructional materials, and the classroom use of designated instructional materials, impacts were more commonly reported among teachers in K–8 science projects than in either K–8 or 6–12 mathematics projects. The apparent greater effectiveness of K–8 science projects may be due to teachers having more room to learn and change when it comes to elementary science content and instructional materials.

It is important to note that although the results of these analyses provide evidence of the impact of the LSC, they should not be interpreted as being definitive. Many of the measures used in these analyses are based upon self-reported data. In addition, teacher participation in LSC professional development is voluntary, and the danger of selection bias in the sample does exist.