

**LSC Project Ratings Study:
An Analysis of Data Collected Between 1997 and 2003**

by

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November 2004

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INTRODUCTION

In 1995 the National Science Foundation initiated the Local Systemic Change (LSC) through Teacher Enhancement program to improve instruction in science, mathematics, and technology. Through the LSC program, 88 individual projects were funded, typically in 1 of 4 targeted areas—K–8 science, K–8 mathematics, 6–12 mathematics, or 6–12 science—though some projects targeted 2 of these 4 areas (e.g., K–12 mathematics, or K–8 science and mathematics). LSC projects were expected to provide 130 hours of professional development to each targeted teacher over the course of its funding, with the emphasis on preparing teachers to implement exemplary science and mathematics instructional materials and lessons in their classes.¹

As part of the core evaluation, LSC evaluators rated various components of a project. The first area rated was the quality of the professional development program. Evaluators judged five aspects of the professional development program, and then assigned an overall quality rating to the program. Thus, for the quality of the professional development program, the following six aspects were examined:

- Culture of the professional development program;
- Quality of preparation of professional development providers;
- Helping teachers become familiar with the designated instructional materials and learn the appropriate pedagogy to develop students' conceptual understanding of mathematics/science;
- Deepening teachers' understanding of mathematics/science content;
- Supporting teachers as they implement the designated instructional materials in their classroom; and
- Overall program rating.

The second area rated was the supportiveness of context for the LSC reforms. The outcomes examined in these models were:

- Alignment of district policies;
- Stakeholder support; and
- Overall rating of support for the LSC reforms.

The final area investigated was the likelihood of institutionalization of the LSC reforms. The outcomes examined in these models were:

- Systems for professional development;
- Systems for aligning district policies;
- Systems for garnering and maintaining stakeholder support; and
- Overall rating of the likelihood of institutionalization of the LSC reforms.

This study utilizes hierarchical modeling to examine how these ratings evolve as projects mature.

¹ Prior to 1999, the requirement for K–8 projects was 100 hours.

SAMPLE

Although the LSC core evaluation began in 1995, the project ratings form was not included as part of the core evaluation until 1997. This study utilizes data from 85 projects that submitted ratings between 1997 and 2003.²

Projects targeted specific grade levels (K–8 and/or 6–12) and subjects (mathematics and/or science). Table 1 displays the number of projects included on this study by targeted subject/grade-level. There are roughly equal numbers of science and mathematics projects, but nearly three times as many K–8 projects as 6–12 projects.

Table 1
Project Subject/Grade-Level

	Number of Projects
K–8 Science	42
K–8 Mathematics	29
6–12 Mathematics	19
6–12 Science	7
Total	85[†]

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

The number of teachers targeted by a project was used to control for differences in project size. Regression analysis assumes that the variables utilized are multivariate normal. Because the distribution of the number of teachers targeted by projects deviated substantially from a normal distribution, the variable was transformed; a square root transformation resulted in the distribution closest to normal. Table 2 displays summary data for both the original and the transformed variable. The average number of targeted teachers for all projects is 858. The smallest project targeted only 49 teachers while the largest targeted 4,079.

Table 2
Number of Targeted Teachers

	Minimum	Maximum	Mean	Std. Dev.
Original	49.00	4,079.00	858.47	708.02
Transformed—Square Root	7.00	90.32	28.99	14.49

Projects are rated on the quality of their professional development program each year; ratings of support and institutionalization are submitted only in a project’s Baseline Year, Year Two, and Final Year. Thus, the analyses presented in this report are based on two data sets. The first data set, used for the analyses of the quality of professional development programs, includes 332 data

² Due to incomplete data, one K–8 science project is included in the quality of professional development program analyses, but not in the analyses of support and institutionalization.

points representing 85 LSC projects at various time points. As can be seen in Table 3, the number of time points per project in this data set ranges from 1 to 6, with about 75 percent of projects having data at 3, 4, or 5 points in time.

Table 3
Number of Data Points per Project,
Quality of Professional Development Program Analyses

	Number of Projects	Percent of Projects
1 Data Point	2	2
2 Data Points	10	12
3 Data Points	20	23
4 Data Points	24	28
5 Data Points	20	24
6 Data Points	9	11
Total	85	100

The second data set, used for the analyses of support for and likelihood of institutionalization of the LSC reforms, contains 210 data points, although the exact number of cases used in each analysis varies due to patterns of missing data. The number of data points per project ranges from 1 to 4³ (see Table 4), with about 85 percent of projects having 2 or 3 data points.

Table 4
Number of Data Points per Project,
Support and Institutionalization Analyses

	Number of Projects	Percent of Projects
1 Data Point	3	4
2 Data Points	44	52
3 Data Points	29	34
4 Data Points	8	10
Total	84	100

³ Projects had the opportunity to submit data on three occasions. However, during the Final Year of data collection, projects were asked to rate the likelihood of institutionalization at that time and to predict the likelihood of institutionalization after the project ended.

ANALYSIS AND RESULTS

This study investigated three areas of interest: (1) quality of professional development, (2) district/stakeholder support for LSC programs, and (3) the likelihood that the LSC reforms will become institutionalized. For the quality of professional development analysis, two-level hierarchical models with time points nested in projects were used to explore the relationship between program ratings and project age.⁴ 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, 1992⁵).

Quality of Professional Development

The evaluator of each LSC project was asked to rate the quality of that project's professional development program, providing an overall rating and ratings on five specific dimensions:

- Culture of the professional development program;
- Quality of preparation of professional development providers;
- Helping teachers become familiar with the designated instructional materials and learn the appropriate pedagogy to develop students' conceptual understanding of mathematics/science;
- Deepening teachers' understanding of mathematics/science content; and
- Supporting teachers as they implement the designated instructional materials in their classrooms.

These outcomes are measured on five-point scales, with 1 being low and 5 being high. Table 5 shows the distribution of ratings for each of these outcomes, by project year.⁶ Due to the small number of projects rated as Level 1 on these outcomes, Levels 1 and 2 were combined for these analyses.

⁴ The specifics of the models used, both for ordinal and continuous outcomes, are presented in Appendix A.

⁵ Bryk, A. S. & Raudenbush, S. W. (1992). *Hierarchical linear models: Applications and data analysis methods*. Newbury Park, CA: Sage Publications.

⁶ The number of cases available for each outcome varies due to changes in the instrument in 1998–99 and 1999–2000. The instrument did not change after 1999–2000.

Table 5
Evaluator Ratings[†] of the LSC Professional Development Program,
by Project Year

	Percent of Projects				
	Baseline Year	Year One	Year Two	Interim Year	Final Year
Overall program rating (N = 331)					
Low	11	4	1	0	0
Medium	68	63	51	40	30
High	18	30	38	46	49
Very High	3	4	10	14	21
Culture of the professional development program (N = 291)					
Low	0	2	0	1	0
Medium	45	22	17	15	5
High	31	56	52	47	51
Very High	24	20	31	37	44
Quality of preparation of professional development providers (N = 291)					
Low	0	10	0	0	2
Medium	38	20	14	16	10
High	48	51	60	46	43
Very High	14	20	26	38	46
Helping teachers become familiar with the designated instructional materials and learn the appropriate pedagogy to develop students' conceptual understanding of mathematics/science (N = 291)					
Low	17	12	0	1	2
Medium	24	24	26	18	18
High	48	46	64	63	48
Very High	10	17	10	19	33
Deepening teachers' understanding of mathematics/science content (N = 331)					
Low	13	11	4	3	2
Medium	47	39	41	38	39
High	34	41	41	44	43
Very High	5	9	14	16	16
Supporting teachers as they implement the designated instructional materials in their classroom (N = 323)					
Low	13	9	3	4	7
Medium	43	33	45	32	30
High	33	35	38	45	33
Very High	10	22	14	19	31

[†] Evaluators rated programs on a five-point scale, where 1 and 2 are considered low ratings, 3 a medium rating, 4 a high rating, and 5 a very high rating.

As noted earlier, the analysis of professional development quality utilized a two-level hierarchical model, with time points nested in projects. Project year was the only variable included at the time point level. At the project level, project size and subject/grade-level were used as control variables, for initial status and, when growth rates varied across projects, for change over time.

The regression coefficients for each model are shown in Table 6. Due to the transformation of the outcome variable (see Appendix A), care is needed in interpreting these regression coefficients. In general, a negative coefficient indicates that higher scores on the predictor

variable are associated with lower probabilities of a low rating on the outcome and higher probabilities of a high rating, while a positive coefficient is associated with increasing probabilities of a low rating and decreasing probabilities of a high rating.

The results of these analyses indicate that evaluator ratings of the overall quality of the professional development program tend to increase significantly over time. The same pattern was found on 4 of the 5 dimensions on which projects were rated: culture of the professional development program, quality of preparation of the professional development providers, helping teachers become familiar with the LSC-designated instructional materials/pedagogy, and deepening teachers' mathematics/science content knowledge. The positive coefficient for secondary science projects indicates that these projects tended to receive lower ratings on all of the outcomes except for helping teachers become familiar with the LSC-designated instructional materials/pedagogy.

Table 6
Regression Coefficients and Standard Errors, by Outcome

	Overall Rating	Culture	Quality of PD Providers	Instructional Materials/ Pedagogy	Content	Support
Intercept	-3.67*** (0.57)	-4.80*** (0.81)	-4.00*** (0.59)	-3.45*** (0.53)	-3.45*** (0.43)	-3.88*** (0.43)
Transformed Number of Targeted Teachers	0.04 (0.03)	0.01 (0.02)	0.01 (0.02)	0.04 (0.05)	0.03 (0.04)	0.00 (0.03)
K-8 Science	0.69 (1.25)	0.95 (0.94)	1.49 (0.96)	-0.41 (1.67)	0.65 (1.49)	-0.02 (1.50)
K-8 Mathematics	-0.05 (1.06)	0.56 (0.79)	0.33 (0.81)	-0.71 (1.44)	0.48 (1.25)	-0.37 (1.24)
6-12 Mathematics	0.03 (1.08)	0.84 (0.80)	0.96 (0.83)	-0.53 (1.50)	-1.04 (1.28)	-0.58 (1.28)
6-12 Science	4.05** (1.33)	1.92* (0.96)	2.29* (0.98)	2.39 (1.64)	2.88 (1.47)	3.95** (1.52)
Project Year	-0.67*** (0.12)	-0.44*** (0.10)	-0.50*** (0.10)	-0.43** (0.13)	-0.26* (0.11)	-0.09 (0.09)
Transformed Number of Targeted Teachers	-0.01 (0.01)	—	—	-0.01 (0.01)	-0.00 (0.01)	0.00 (0.01)
K-8 Science	0.17 (0.57)	—	—	0.39 (0.60)	-0.06 (0.54)	0.23 (0.49)
K-8 Mathematics	0.01 (0.47)	—	—	0.32 (0.51)	0.33 (0.47)	0.18 (0.40)
6-12 Mathematics	0.18 (0.49)	—	—	0.40 (0.54)	0.33 (0.47)	0.51 (0.42)
6-12 Science	-0.62 (0.58)	—	—	0.22 (0.60)	-0.51 (0.53)	-0.46 (0.48)
Threshold2	5.18*** (0.56)	3.87*** (0.76)	3.19*** (0.52)	2.89*** (0.38)	3.77*** (0.33)	3.53*** (0.34)
Threshold3	8.24*** (0.62)	6.92*** (0.79)	6.39*** (0.56)	6.73*** (0.46)	6.85*** (0.40)	6.04*** (0.39)

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

To better illustrate the relationship between project year and the outcomes, Table 7 shows the predicted probabilities of a project receiving a low, medium, high, or very high rating in each category.

Table 7
Predicted Probabilities of Ratings of the LSC Professional Development Program,
by Project Year

	Predicted Probability		
	Baseline Year	Year Two	Year Five
Overall program rating*			
Low	0.02	0.01	0.00
Medium	0.79	0.54	0.14
High	0.17	0.42	0.64
Very High	0.01	0.04	0.23
Culture of the professional development program*			
Low	0.01	0.00	0.00
Medium	0.27	0.14	0.04
High	0.61	0.63	0.44
Very High	0.11	0.22	0.52
Quality of preparation of professional development providers*			
Low	0.02	0.01	0.00
Medium	0.29	0.13	0.03
High	0.61	0.66	0.44
Very High	0.08	0.20	0.53
Helping teachers become familiar with the designated instructional materials and learn the appropriate pedagogy to develop students' conceptual understanding of mathematics/science*			
Low	0.03	0.01	0.00
Medium	0.33	0.18	0.06
High	0.60	0.72	0.69
Very High	0.04	0.08	0.24
Deepening teachers' understanding of mathematics/science content*			
Low	0.03	0.02	0.01
Medium	0.55	0.43	0.26
High	0.39	0.50	0.62
Very High	0.03	0.05	0.11
Supporting teachers as they implement the designated instructional materials in their classroom			
Low	0.02	0.02	0.01
Medium	0.39	0.35	0.30
High	0.48	0.51	0.54
Very High	0.10	0.12	0.15

District/Stakeholder Support for LSC Programs

For the analysis of district and stakeholder support for reform project year was again the only variable included at the time point level. At the project level, project size and subject/grade-level were included as control variables.

At the end of a project’s Baseline Year (project year zero), Year Two, and Final Year (typically project year five), evaluators and Principal Investigators collaborated to rate the extent to which a variety of district policies (e.g., curriculum frameworks, process for selecting instructional materials, district-wide assessments, etc.) facilitated/inhibited the process of reform in LSC districts. They also rated the extent to which various stakeholder groups such as parents, teachers, and principals, supported/opposed the LSC reforms. A composite measuring each of the two constructs was created based on responses to each set of items at each of these time points. (See Appendix B for composite definitions and reliabilities.)

- *Alignment of District Policies with LSC Vision* (e.g., district policies’ and practices’ impact on mathematics/science curriculum framework, and district-wide student assessment); and
- *Stakeholder Support for Mathematics/Science Reforms* (e.g., attitudes and beliefs about reform from principals, and parents)

Table 8 provides descriptive statistics for these composites at each time point. The number of projects with Baseline Year data is relatively small as a number of projects were funded in the years prior to the creation of the project ratings form.

Table 8
Descriptive Statistics for District and Stakeholder Support Composites,
by Project Year

	N	Minimum	Maximum	Mean	Std. Dev.
Alignment of district policies with LSC vision					
Baseline Year	30	45.71	94.29	67.33	10.58
Year Two	58	40.00	94.29	73.50	12.43
Final Year	61	42.86	100.00	76.54	13.05
Stakeholder support for mathematics/science reforms					
Baseline Year	30	55.00	85.00	72.00	8.77
Year Two	58	50.00	95.00	75.60	8.94
Final Year	61	55.00	100.00	78.03	9.84

In addition to the individual indicator ratings, evaluators and PIs provided an overall rating of the extent to which there was a supportive environment for the LSC reforms using a scale ranging from “Level 1: predominance of non-supportive context” to “Level 5: exemplary supportive context.” These continuum ratings are shown in Table 9.

Table 9
Continuum Ratings for Extent of Support of the LSC Reforms,
by Project Year

	Percent of Projects		
	Baseline Year (N = 30)	Year Two (N = 58)	Final Year (N = 61)
Level 1: Predominance of Non-Supportive Context	0	0	0
Level 2: Exploring Supportive Context	10	10	5
Level 3: Transitioning Toward a Supportive Context	70	40	23
Level 4: Emerging Supportive Context	20	45	59
Level 5: Exemplary Supportive Context in Place	0	5	13

Regression coefficients and standard errors for the regression models are reported in Table 10. Again, care is needed in interpreting the regression coefficients for the overall continuum rating of support. For that outcome, a negative coefficient indicates a lower probability of receiving a low rating. For the two composites, a negative coefficient indicates a negative correlation between the independent variable and the outcome.

Project year is a significant predictor of all three outcomes; the positive changes in the outcomes over time illustrated in Tables 7 and 8 are statistically significant. Larger projects tended to receive lower ratings on the overall continuum rating and lower scores on the alignment of district policies composite. Project subject/grade-level was not a consistent predictor of the outcome variables.

Table 11 shows the predicted probabilities (the probability based upon the regression equation that a project will receive a particular rating) for the continuum rating. A project had a 22 percent chance of receiving a rating of level 4 or level 5 in its Baseline Year, compared to a 77 percent chance in its Final Year.

Table 10
Regression Coefficients and Standard Errors, by Outcome

	Overall Continuum Rating of Extent of Support of the LSC Reforms	Alignment of District Policies with the LSC Vision	Stakeholder Support for Mathematics/ Science Reforms
Intercept	-2.13*** (0.51)	68.75*** (1.82)	73.50*** (1.41)
Transformed Number of Targeted Teachers	0.07* (0.03)	-0.24 [†] (0.13)	-0.13 (0.09)
K-8 Science	-2.14 [†] (1.25)	7.12 (5.51)	4.13 (4.04)
K-8 Mathematics	-1.49 (1.05)	6.70 (4.64)	1.20 (3.40)
6-12 Mathematics	-0.68 (1.05)	-1.20 (4.67)	-1.29 (3.41)
6-12 Science	-0.16 (1.26)	-1.28 (5.68)	-4.12 (4.15)
Project Year	-0.53*** (0.12)	1.61** (0.46)	0.92* (0.37)
Threshold 2	3.54*** (0.44)	—	—
Threshold 3	7.41*** (0.62)	—	—

[~] p < 0.10; * p < 0.05; ** p < 0.01; *** p < 0.001

[†] The continuum rating is an ordinal outcome. Negative regression coefficients indicate that higher values of the independent variable are associated with a greater probability of a project being rated in the higher categories of the outcome variable; positive regression coefficients indicate that higher values of the independent variable are associated with a greater probability of a project being rated in the lower categories of the outcome variable.

Table 11
Predicted Probabilities for the Continuum Rating of Extent of Support of the LSC Reforms

	Predicted probabilities*		
	Baseline Year	Year Two	Final Year
Level 1: Predominance of Non-Supportive Context	0.00	0.00	0.00
Level 2: Exploring Supportive Context	0.10	0.04	0.01
Level 3: Transitioning Toward a Supportive Context	0.68	0.54	0.23
Level 4: Emerging Supportive Context	0.21	0.41	0.70
Level 5: Exemplary Supportive Context in Place	0.01	0.02	0.07

Figure 1 illustrates the relationship between project year and the composite scores. The regression equations were used to predict composite scores for a “typical” project. The figure indicates that district policies tended to facilitate the LSC reforms, even at the beginning of the LSC projects, and became more facilitative as projects matured (an effect size of 0.25 standard deviations). Similarly, the stakeholder support composite shows that support for the LSC tended to be positive initially and to increase over time (an effect size of 0.19 standard deviations).

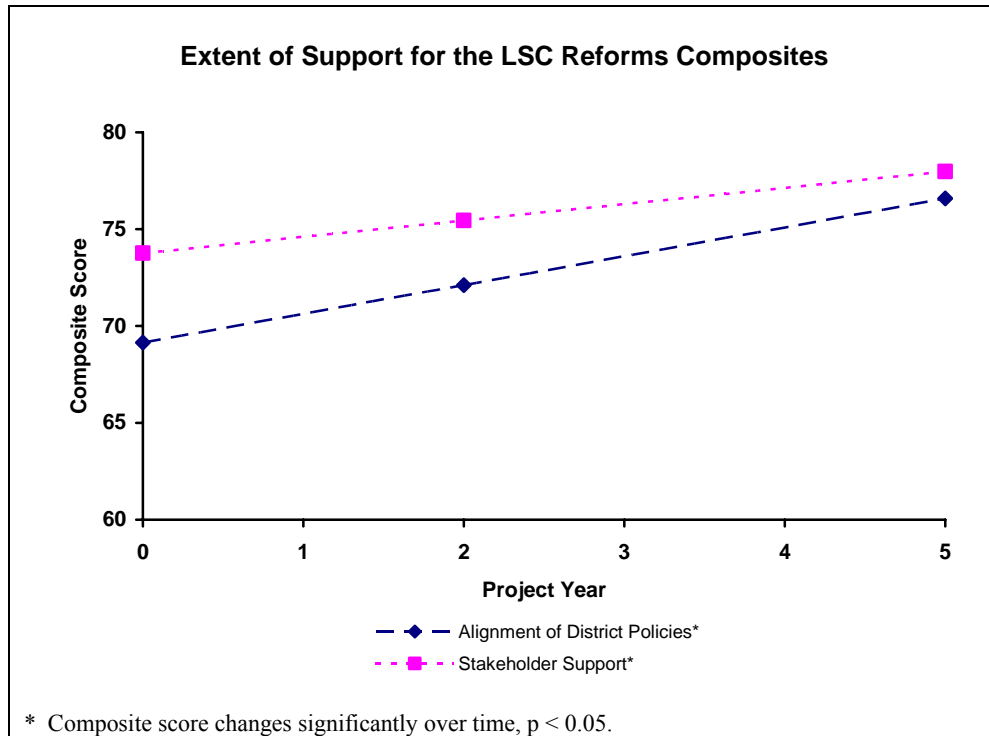


Figure 1

Likelihood that the LSC Reform Will Become Institutionalized

For the analysis of district and stakeholder support for reform, and likelihood of institutionalization of the LSC reforms, project year was again the only variable included at the time point level. At the project level, project size and subject/grade-level were included as control variables.

Evaluators and PIs also collaborated on ratings regarding the extent to which districts had the capacity, infrastructure, and resources devoted to mathematics/science reform at various stages of the project (baseline year, year two, and final year) and predicted the likelihood that these systems would exist after LSC funding. These ratings were combined into three composites (see Appendix B for reliability tables):

- *Systems for planning and implementing mathematics/science professional development* (e.g., having structures in place for assessing teachers' needs, having the capacity to plan and deliver high quality professional development, and having incentives for teachers to participate in ongoing professional development);
- *Systems for aligning policies with the LSC reform vision* (e.g., aligning curriculum frameworks, assessments, and teacher evaluations with the LSC vision); and

- *Systems for garnering and maintaining stakeholder support* (e.g., targeted teachers, principals, and parents).

Table 12 shows descriptive statistics for these composites at each time point.

Table 12
Descriptive Statistics for Likelihood of Institutionalization Composites,
by Project Year

	N	Minimum	Maximum	Mean	Std. Dev.
Systems for planning and implementing mathematics/science professional development					
Baseline Year	30	24.44	75.56	55.63	13.90
Year Two	58	35.56	97.78	77.97	12.54
Final Year	61	46.67	100.00	80.87	11.23
Predicted Future	61	44.44	100.00	76.03	13.44
Systems for aligning policies with the LSC reform vision					
Baseline Year	30	22.86	85.71	55.62	16.38
Year Two	58	25.71	97.14	71.76	12.61
Final Year	61	48.57	100.00	75.83	11.72
Predicted Future	61	45.71	100.00	74.43	12.49
Systems for garnering and maintaining stakeholder support					
Baseline Year	30	20.00	82.86	56.10	14.92
Year Two	58	20.00	94.29	67.34	14.23
Final Year	61	48.57	100.00	74.10	11.08
Predicted Future	61	45.71	100.00	71.62	12.18

At the end of each project’s second and final year, the evaluator and PI were asked to provide an overall rating of the likelihood of institutionalization of the LSC reforms using a scale ranging from “Level 1: likely to snap back at the end of the LSC” to “Level 5: long term institutionalization is likely.” By Year Two, districts in over 70 percent of projects submitting ratings were expected to institutionalize many, if not all, of the LSC reforms (see Table 13).

Table 13
Continuum Ratings of Likelihood of Institutionalization of LSC Reforms

	Percent of Projects	
	Year Two (N = 58)	Final Year (N = 61)
Level 1: Rubber Band Likely to Snap Back	0	0
Level 2: LSC Reforms Likely to Gradually Fade Away	0	2
Level 3: Minor Components Likely to Become Institutionalized	30	19
Level 4: Components Likely to Become Institutionalized	63	62
Level 5: Institutionalization of LSC Reforms Likely	8	17

Because projects could have up to four time-points for the composites, it was possible to test more complex relationships between the outcomes and project year. Thus, the square and cube of project year were included in the institutionalization composite models. Table 14 displays regression coefficients and standard errors for each outcome variable related to institutionalization of LSC reforms. Project year is a significant predictor of ratings for the three

composite outcome variables. In regards to the overall continuum rating of institutionalization of the LSC reforms, project year is not a significant predictor. This finding is an indication that projects continued to have expectations for institutionalization as NSF-funding was drawing to an end.

To illustrate the relationship between project year and the composites, Figure 2 shows predicted scores for the three composites. LSC districts typically did not have strong systems in place prior to the LSC (year one) for any of the three purposes. However, districts were much more likely to have these systems in place by Year Two and to maintain them until their Final Year (typically year five). Between these two time points, there was an average yearly gain of 0.31, 0.25, and 0.23 standard deviations on the three composites. Although evaluators and PIs predicted a slight drop-off in these systems after LSC funding (coded as project year seven), many of the gains made during the LSC were expected to be sustained.

Table 14
Regression Coefficients and Standard Errors, by Outcome

	Continuum Rating of Institutionalization of LSC Reforms	Systems for Professional Development	Systems for Aligning District Policies	Systems for Garnering and Maintaining Stakeholder Support
Intercept	-4.73** (1.33)	56.67*** (2.02)	55.99*** (1.97)	56.35*** (2.04)
Transformed Number of Targeted Teachers	0.04 (0.03)	-0.27* (0.12)	-0.32* (0.13)	-0.21 (0.13)
K-8 Mathematics	-0.54 (1.39)	15.16** (5.55)	10.87 (5.85)	12.19* (5.78)
K-8 Science	-0.42 (1.18)	11.25* (4.66)	11.38* (4.91)	8.42~ (4.85)
6-12 Mathematics	0.35 (1.19)	7.95~ (4.68)	2.84 (4.94)	2.10 (4.88)
6-12 Science	2.06 (1.40)	6.45 (5.80)	6.03 (6.11)	6.64 (6.04)
Project Year	-0.21 (0.18)	15.96*** (1.90)	11.76*** (1.74)	6.63** (1.88)
Project Year Squared	—	-3.12*** (0.62)	-2.25*** (0.57)	-0.59 (0.62)
Project Year Cubed	—	0.17** (0.06)	0.13* (0.05)	-0.01 (0.06)
Threshold 2	4.13** (1.17)	—	—	—
Threshold 3	7.95*** (1.24)	—	—	—

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

† The continuum rating is an ordinal outcome. Negative regression coefficients indicate that higher values of the independent variable are associated with a greater probability of a project being rated in the higher categories of the outcome variable; positive regression coefficients indicate that higher values of the independent variable are associated with a greater probability of a project being rated in the lower categories of the outcome variable.

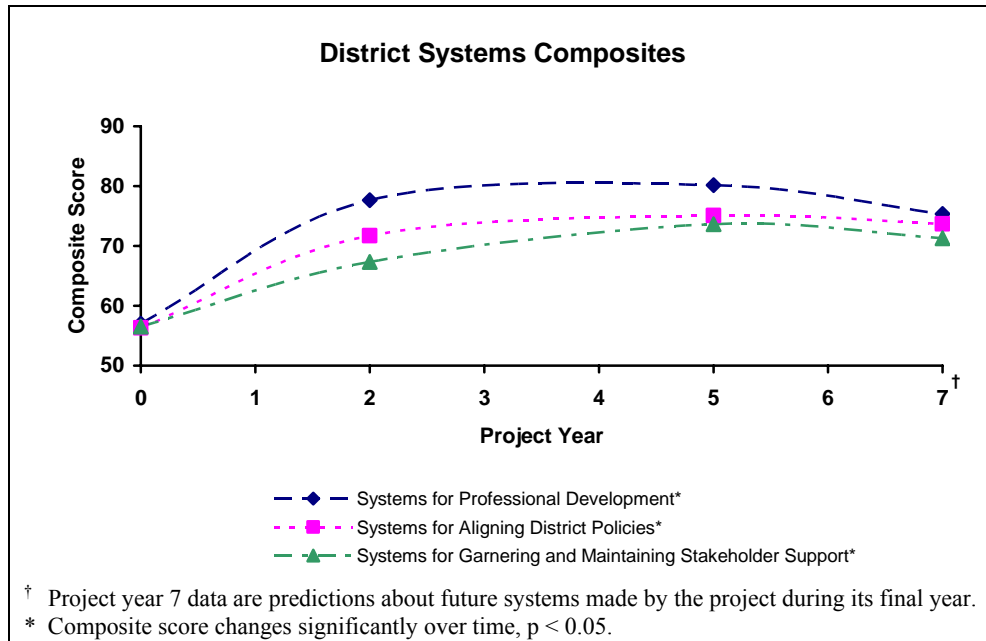


Figure 2

CONCLUSIONS

The analyses presented in this report shed some light on the LSC program as projects evolve over time. In regards to the quality of professional development programs, evaluator ratings of overall quality increased significantly over time. Ratings of the professional development culture, quality of professional development providers, quality of professional development focused on the LSC-designated instructional materials/pedagogy, and quality of professional development focused on deepening teachers' mathematics/science content knowledge also increased significantly over time. The quality of follow-up support provided to teachers was the only aspect of the professional development program that did not receive higher ratings as projects matured. Secondary science projects tended to receive lower ratings than other projects on both the overall rating and on ratings of culture, quality of professional development providers, and quality of follow-up support.

The analysis of project ratings also indicates that the LSCs operated in environments of increasing support, both in terms of alignment of district policies with the LSC vision and stakeholder support for the LSC reforms. However, projects that targeted greater numbers of teachers tended to score lower than smaller projects on the rating of overall support and the alignment of district policies composite.

In regards to institutionalization of the LSC reforms, the project ratings data indicate that the LSCs were effective at building systems within participating districts to provide on-going professional development, to continue aligning district policies with the LSC vision, and to garner and maintain stakeholder support. Furthermore, at the end of the LSC funding, PIs and evaluators were still optimistic about the likelihood of institutionalization of the LSC reforms.

APPENDIX A

This study utilized two types of hierarchical models, one for ordinal outcomes and another for continuous outcomes.

Ordinal Outcome Models

Conceptually, each dimension within time points was treated as an event with a probability of receiving a low (Level 1 or 2), medium (Level 3), high (Level 4), or very high (Level 5) rating that is related to characteristics of the program and project year. The analysis produces estimates that can be translated into predicted probabilities that a program will receive a particular rating given the specific characteristics of the program and project year.

For these analyses, the program is conceptualized as an event with an underlying distribution of probabilities that its rating will be in each category. The analysis produces estimates of the likelihood that a program will be rated in each category based on the independent variables in the model. The statistical model for analyzing ordinal outcomes is a hierarchical generalized model. In the model, a “log odds” transformation of the probability for each rating category is estimated. The final estimates can then be converted to probabilities for ease of interpretation.

The outcome variable was organized as follows:

$$\begin{aligned}
 Y_{ij} &= X = \text{Rating for time point } i \text{ in project } j \\
 X = L &= \text{Rating in Low category (1, 2)} \\
 X = M &= \text{Rating in Medium category (3)} \\
 X = H &= \text{Rating in High category (4)} \\
 X = V &= \text{Rating in Very High category (5)}
 \end{aligned}$$

$$\begin{aligned}
 Y_{Xij} &= 1, \text{ if the capsule rating is in or below category } X \\
 Y_{Xij} &= 0, \text{ if the capsule rating is above category } X
 \end{aligned}$$

$$\begin{aligned}
 P(Y_{ij} = X) &= \varphi_{Xi} = \text{probability that the capsule rating is in category } X \\
 P(Y_{Xij} = 1) &= \varphi_{Xij}^* = \text{probability that the capsule rating is in or below category } X
 \end{aligned}$$

$$\begin{aligned}
 \varphi_{Lij} &= \varphi_{Lij}^* \\
 \varphi_{Mij} + \varphi_{Lij} &= \varphi_{Mij}^* \\
 \varphi_{Hij} + \varphi_{Mij} + \varphi_{Lij} &= \varphi_{Hij}^* \\
 \varphi_{Vij} + \varphi_{Hij} + \varphi_{Mij} + \varphi_{Lij} &= \varphi_{Vij}^* = 1
 \end{aligned}$$

The expected value and variance for each category of the ordinal outcome variable are:

$$\begin{aligned}
 E(Y_{Xij}) &= \varphi_{Xij}^* \\
 \text{Var}(Y_{Xij}) &= \frac{\varphi_{Xij}^*}{1 - \varphi_{Xij}^*}
 \end{aligned}$$

A logit link function was used to transform the ordinal outcome variable to estimate three values in model:

$$\eta_{Lij} = \ln\left(\frac{\varphi^*_{Lij}}{1 - \varphi^*_{Lij}}\right)$$

$$\eta_{Mij} = \ln\left(\frac{\varphi^*_{Mij}}{1 - \varphi^*_{Mij}}\right)$$

$$\eta_{Hij} = \ln\left(\frac{\varphi^*_{Hij}}{1 - \varphi^*_{Hij}}\right)$$

Using this transformation, η_{Xij} is the logarithm of the predicted odds (or “log-odds”) of a session being rated in or below category X. Since the estimated outcomes are the log odds of a capsule rating in or below each category, the predicted probability of a rating in or below each category for any session can be obtained by reversing the transformation using the formula:

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

From these values, the predicted probabilities for a rating in each category can be computed.

Example Ordinal Model Equation:

Level 1:

$$\begin{aligned}\eta_{Lij} &= B_0 + B_1 * (\text{Project Year}) \\ \eta_{Mij} &= B_0 + B_1 * (\text{Project Year}) + d(2) \\ \eta_{Hij} &= B_0 + B_1 * (\text{Project Year}) + d(3)\end{aligned}$$

Level 2:

$$\begin{aligned}B_0 &= G_{00} + G_{01} * (\text{Project Size}) + G_{02} * (\text{K-8 science}) + G_{03} * (\text{K-8 mathematics}) + G_{04} * (\text{6-12 mathematics}) + \\ &\quad G_{05} * (\text{6-12 science}) + U_0 \\ B_1 &= G_{10} + G_{11} * (\text{Project Size}) + G_{12} * (\text{K-8 science}) + G_{13} * (\text{K-8 mathematics}) + G_{14} * (\text{6-12 mathematics}) + \\ &\quad G_{15} * (\text{6-12 science}) + U_1\end{aligned}$$

Continuous Outcome Models

The form of the regression equation for a hierarchical model of a continuous outcome variable is provided below.

Level 1:

$$Y = B_0 + B_1*(\text{Project Year}) + B_2*(\text{Project Year squared}) + B_3*(\text{Project Year cubed}) + R$$

Level 2:

$$B_0 = G_{00} + G_{01}*(\text{Project Size}) + G_{02}*(\text{K-8 science}) + G_{03}*(\text{K-8 mathematics}) + G_{04}*(\text{6-12 mathematics}) + G_{05}*(\text{6-12 science}) + U_0$$

$$B_1 = G_{10} + G_{11}*(\text{Project Size}) + G_{12}*(\text{K-8 science}) + G_{13}*(\text{K-8 mathematics}) + G_{14}*(\text{6-12 mathematics}) + G_{15}*(\text{6-12 science}) + U_1$$

$$B_2 = G_{20} + G_{21}*(\text{Project Size}) + G_{22}*(\text{K-8 science}) + G_{23}*(\text{K-8 mathematics}) + G_{24}*(\text{6-12 mathematics}) + G_{25}*(\text{6-12 science}) + U_2$$

Appendix B

Composite Definitions and Reliabilities

Alignment of District Policies with the LSC Vision

Cronbach's Alpha = 0.80

- Mathematics/science curriculum framework/scope and sequence
- Selection of instructional materials
- System for purchasing and managing materials and supplies
- District-wide student assessment
- Evaluation of teacher performance
- Consistency of LSC mathematics/science reforms with other district reforms
- Organizational structures/policies within schools

Stakeholder Support for Mathematics/Science Reforms

Cronbach's Alpha = 0.60

- Teachers targeted by the LSC
- Principals
- Central office administrators
- Parents

Likelihood of Institutionalization of LSC Professional Development

Cronbach's Alpha = 0.90

- The district has structures in place for assessing teachers' needs
- The district has the capacity to plan and deliver high-quality math/science professional development internally
- The district can plan and deliver high-quality math/science professional development through an external group
- The district ties professional development specifically to the mathematics/science curriculum
- The district provides teachers with the opportunity for a coherent professional development program
- The district has incentives in place for teachers to participate in ongoing professional development
- The district uses staff development days for mathematics/science professional development
- The district provides teachers with support as they implement what they learned in professional development
- The district has systems in place for orienting new teachers

Likelihood of Continued Alignment of District Policies with the LSC Vision

Cronbach's Alpha = 0.83

- The district has a system in place to align math/science curriculum framework/scope/sequence with the math/science reform vision
- The district has a system in place to align the selection of instructional materials with the math/science reform vision
- The district has a system in place to align purchasing and managing supplies and materials with the math/science reform vision
- The district has a system in place to align district-wide student assessments with the math/science reform vision
- The district has a system in place to align the recruiting/hiring of new teachers with the math/science reform vision
- The district has a system in place to align the evaluation of teacher performance with the math/science reform vision
- The district has a system in place to align organizational structures/policies within schools with the math/science reform vision

Likelihood of Continued Stakeholder Support for Mathematics/Science Reform

Cronbach's Alpha = 0.83

- The district has a system in place for garnering and maintaining support for math/science reform from teachers targeted by the LSC
- The district has a system in place for garnering and maintaining support for math/science reform from principals
- The district has a system in place for garnering and maintaining support for math/science reform from central office administrators
- The district has a system in place for garnering and maintaining support for math/science reform from parents
- The district has a system in place for garnering and maintaining support for math/science reform from institutions of higher education
- The district has a system in place for garnering and maintaining support for math/science reform from other math/science-rich institutions
- The district has a system in place for garnering and maintaining support for math/science reform from teacher unions