Test-Retest Reliability of the Local Systemic Change Teacher Questionnaire

by

Amy A. Germuth
Eric R. Banilower
Elizabeth S. Shimkus

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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

In 1995, the National Science Foundation (NSF) initiated the Local Systemic Change through Teacher Enhancement program to improve instruction in science, mathematics, and technology. In the spring and summer of 1995, NSF funded the first cohort of 8 projects. Eighteen additional projects were funded in 1996, 20 in 1997, 12 in 1998, 13 in 1999, 9 in 2000, 7 in 2001, and 1 in 2002 for a total of 88 projects in Cohorts 1–8.

NSF's solicitation for the LSC initiative indicated the Foundation's interest from the outset in providing a framework for collecting data from LSC projects to evaluate their efforts. The goal of the evaluation activities was not only to assess individual projects, but also to aggregate data across projects to glean broader insights about the design, quality, and impact of the LSCs. NSF contracted with Horizon Research, Inc. (HRI) in Chapel Hill, North Carolina to develop a data collection framework, to provide technical assistance in implementing evaluation activities, and to prepare cross-site analyses of evaluation results.

Since the LSC's inception, HRI has collaborated with NSF staff, LSC PIs, and project evaluators on the design and implementation of a core evaluation system. All of the evaluation activities are driven by a set of core evaluation questions:

- What is the overall quality of the LSC professional development activities?
- What is the extent of school and teacher involvement in LSC activities?
- What is the impact of the LSC professional development on teacher preparedness, attitudes, and beliefs about mathematics and science teaching and learning?
- What is the impact of the LSC on classroom practices in mathematics and science?
- To what extent are the district and school contexts becoming more supportive of the LSC vision for exemplary mathematics and science education?
- What is the extent of institutionalization of high quality professional development systems in the LSC districts?

In order to address these questions cross-site, a number of evaluation instruments were developed and used by each LSC project. Among the instruments developed for the LSC was a teacher questionnaire that has served as one of the main sources of data and has been used to address many of the LSC evaluation questions. This study is designed to assess the test-retest reliability of the LSC teacher questionnaire.

The LSC Teacher Questionnaire

The teacher questionnaire was developed by HRI with the assistance of NSF staff, LSC PIs, and project evaluators, to help answer several of the core evaluation questions. Expert review has helped establish the validity of the instrument. The items of main interest on the questionnaire relate to teachers' attitudes toward reform-based teaching, and teachers' perceptions of their mathematics/science content preparedness, pedagogical preparedness, classroom practices, and principal support. The items on the questionnaire that address these areas were combined into a set of composite variables through factor analysis[1] to provide more reliable estimates of teachers' preparedness and classroom practices.[2]

The eight composites of interest in this study are:

1. Attitudes toward reform-based teaching;
2. Perceptions of pedagogical preparedness;
3. Perceptions of mathematics/science content preparedness;
4. Use of traditional teaching practices;
5. Use of practices that foster an investigative culture;
6. Use of investigative teaching practices;
7. Perceptions of principal support; and
8. Perceived impact of the LSC.

Internal reliability estimates for these composites have been calculated using Cronbach's alpha and are in the acceptable to very good range. Definitions and reliabilities for these composites are located in the Appendix.

The Sample

This study assesses the test-retest reliability of the teacher questionnaire using responses from over 2,000 teachers who had completed the LSC teacher questionnaire on more than one occasion. Only teachers who had not received any LSC professional development between the two occasions were included since one would expect a teacher's responses to change with treatment. Additionally, the data set was limited to teachers with responses only one year apart as other experiences over an extended period of time could also affect how a teacher responds.

[1] See "Technical Report: Analysis of Psychometric Structure of the LSC Surveys" (12/07/98) by David B. Flora and A.T. Panter, L.L. Thurstone Psychometric Lab, University of North Carolina at Chapel Hill, NC for a detailed description of the factor analysis.

[2] An additional composite was created at a later date to measure teachers' perceived impact of the LSC. This composite is composed of three items asking about the impact of the LSC on a teacher's mathematics/science content knowledge, understanding of how children think about/learn mathematics/science, and ability to implement the LSC-designated instructional materials. This composite is calculated only for those teachers that have already participated in LSC professional development.

In instances where a teacher had three or more complete responses that met these two criteria, one pair of chronologically adjacent responses was chosen randomly.

Finally, teacher leaders were excluded from this study. Even if a teacher leader had received no formal professional development between two occasions of completing the questionnaire, they were likely involved in providing professional development to other teachers. Providing professional development may likely have caused a teacher leader to reflect upon his/her own teaching practices, and thus would have introduced a treatment effect not measured by formal professional development hours.

The analyses described in this report are based upon 2,136 teachers across 62 projects. Table 1 shows the number of teachers included by targeted subject/grade-range.

Table 1
Teachers and Projects Included in Sample

Subject/Grade-Range	Number of Projects[†]	Percent of Projects	Number of Teachers	Percent of Teachers
K–8 Science	32	46	1,052	49
K–8 Mathematics	22	31	757	35
6–12 Mathematics	15	21	304	14
6–12 Science	1	1	23	1
Total	**62**	**100**	**2,136**	**100**

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

Table 2 shows the demographic characteristics of the teachers included in this study. Overall, these teachers are fairly representative of the population of teachers being served by the LSC.[3] As in the LSC as a whole, the majority of teachers included in this study are white and female. Over half of the teachers had at least six years of experience (including their current year) at the time of second response to the questionnaire. Approximately 40 percent of the teachers included in this study indicated they had not yet participated in LSC professional development.

[3] Local Systemic Change through Teacher Enhancement: Year Three Cross-Site Report (1998).

Table 2
Teacher Demographics

	Percent of Teachers
Gender	
Female	84
Male	16
Race/Ethnicity	
African-American	9
American Indian or Alaskan Native	0
Asian/Native Hawaiian/Pacific Islander	2
Hispanic or Latino	7
White	80
Other	1
Years of Teaching Experience	
0–2 Years	11
3–5 Years	13
6–10 Years	15
11–20 Years	24
21 or More Years	37
Hours of Professional Development	
0 Hours	43
1–19 Hours	15
20–79 Hours	28
80 or More Hours	15

Analysis and Results

As can be seen in Table 3, the means and standard deviations for the composite variables at the two time points are quite similar. However, these data do not provide sufficient evidence to establish test-retest reliability.

Table 3
Means and Standard Deviations for Teacher Composite Scores

	Time 1		Time 2	
	Mean	Standard Deviation	Mean	Standard Deviation
Attitudes Toward Teaching	85.46	10.48	85.00	10.67
Perceptions of Pedagogical Preparedness	76.29	13.43	77.21	13.69
Perceptions of Content Preparedness	65.30	17.86	66.37	18.09
Traditional Practices	63.41	20.10	63.24	20.22
Investigative Culture	78.74	13.62	78.74	13.96
Investigative Practices	50.67	14.30	50.94	14.55
Perceptions of Principal Support	75.56	14.51	75.84	13.95
Perceived Impact	70.28	21.64	70.99	20.84

In cases where tests or instruments have high test-retest reliabilities, correlations among responses over time are expected to be high. Typically, Pearson's Product Moment Correlation "r" is used to assess the test-retest reliability of an instrument. Pearson's r can range from -1 to +1. A value of 1 (positive or negative) indicates a perfect linear relationship between the two

variables; a value of 0 indicates no linear relationship between the two variables. Instruments with high test-retest reliability should have values of r closer to 1 than to 0.

As can be seen in Table 4, all correlation coefficients are at least 0.60, ranging between 0.604 and 0.766. The principal support composite has the lowest correlation coefficient, perhaps due to the high rate of principal turnover in schools which makes it likely that some teachers were responding about two different principals on the two occasions of completing the questionnaire. Overall, these results indicate quite high test-retest reliability for the LSC teacher questionnaire.

Table 4
Test-Retest Reliability Coefficients

	Correlation Coefficient
Attitudes Toward Teaching	0.694*
Perceptions of Pedagogical Preparedness	0.729*
Perceptions of Content Preparedness	0.746*
Traditional Practices	0.766*
Investigative Culture	0.664*
Investigative Practices	0.671*
Perceptions of Principal Support	0.604*
Perceived Impact	0.634*

* Correlation coefficient significantly different from 0, $p < 0.05$.

Conclusions

The results of this study provide evidence that the LSC Teacher Questionnaire is quite reliable. Correlation coefficients for each of the eight composites tested is greater than 0.60. These results, added to those of past studies which sought to establish the questionnaire's validity and the internal reliability of the composites, lend considerable evidence that the LSC teacher questionnaire is a valid and reliable measure of teachers' attitudes, preparedness, and classroom practices. Further, it is quite likely that this study underestimates the true test-retest reliability of the instruments since the two administrations of the questionnaire were a year apart. Even if a teacher received no LSC professional development in that year, non-LSC professional development, collaboration/socializing with peers, and personal maturation could affect how a teacher responds, thus lowering the correlation coefficient.

Although the results of this study are promising, there are two concerns regarding its external validity (i.e., generalizability). One concern is the fact that some LSC projects are not represented in the sample. In particular, projects from later cohorts that were not required to administer the teacher questionnaire every year are systematically underrepresented in the sample. However, there is no reason to believe that teachers in these projects would respond to the questionnaire in a different manner from teachers in projects included in the sample.

The second concern centers on whether the questionnaire is equally reliable for each of the subject/grade-range versions. Unfortunately, the relatively small number of teachers in some subject/grade-range combinations prohibits this more specific analysis. This question may be addressable at a future data when more questionnaire data are available.

Appendix

Composite Definitions and Cronbach's Alpha Reliabilities

Composite T2: **Attitudes Towards Teaching**	**K–8 Science**	**K–8 Math**	**6–12 Math**	**6–12 Science**
Provide concrete experience before abstract concepts.	7ia	7ia	8ia	8ia
Develop students' conceptual understanding of science/mathematics.	7ib	7ib	8ib	8ib
Make connections between science/mathematics and other disciplines.	7id	7ie	8ie	8id
Have students work in cooperative learning groups.	7ie	7if	8if	8ie
Have students participate in appropriate hands-on activities.	7if	7ig	8ig	8if
Engage students in inquiry-oriented activities.	7ig	7ih	8ih	8ig
Use computers.	7ih	7ij	8ik	8ij
Engage students in applications of science/mathematics in a variety of contexts.	7ii	7ik	8il	8ik
Use portfolios.	7ik	7im	8in	8im
Use informal questioning to assess student understanding.	7il	7in	8io	8in
Reliability (Cronbach's Coefficient Alpha)	**0.80**	**0.80**	**0.83**	**0.80**

Composite T3: **Pedagogical Preparedness**	**K–8 Science**	**K–8 Math**	**6–12 Math**	**6–12 Science**
Provide concrete experience before abstract concepts.	7pa	7pa	8pa	8pa
Develop students' conceptual understanding of science/mathematics.	7pb	7pb	8pb	8pb
Take students' prior understanding into account when planning curriculum and instruction.	7pc	7pc	8pc	8pc
Make connections between science/mathematics and other disciplines.	7pd	7pe	8pe	8pd
Have students work in cooperative learning groups.	7pe	7pf	8pf	8pe
Have students participate in appropriate hands-on activities.	7pf	7pg	8pg	8pf
Engage students in inquiry-oriented activities.	7pg	7ph	8ph	8pg
Engage students in applications of science/mathematics in a variety of contexts.	7pi	7pk	8pl	8pk
Use performance-based assessment.	7pj	7pl	8pm	8pl
Use portfolios.	7pk	7pm	8pn	8pm
Use informal questioning to assess student understanding.	7pl	7pn	8po	8pn
Lead a class of students using investigative strategies.	11a	12a	14a	12a
Manage a class of students engaged in hands-on/project-based work.	11b	12b	14b	12b
Help students take responsibility for their own learning.	11c	12c	14c	12c
Recognize and respond to student diversity.	11d	12d	14d	12d
Encourage students' interest in science/mathematics.	11e	12e	14e	12e
Use strategies that specifically encourage participation of females and minorities in science/mathematics.	11f	12f	14f	12f
Involve parents in the science/mathematics education of their students.	11g	12g	14g	12g
Reliability (Cronbach's Coefficient Alpha)	**0.94**	**0.93**	**0.92**	**0.93**

Composite T4: Content Preparedness	K–8 Science	K–8 Math	6–12 Math
The human body	10a		
Ecology	10b		
Rocks and soils	10c		
Astronomy	10d		
Processes of change over time (e.g., evolution)	10e		
Mixtures and solutions	10f		
Electricity	10g		
Sound	10h		
Forces and motion	10i		
Machines	10j		
Engineering and design principles (e.g., structures, models)	10k		
Estimation			12a
Measurement			12b
Pre-algebra		10e	12c
Algebra		10f	12d
Patterns and relationships			12e
Geometry and spatial sense		10h	12f
Functions (including trigonometric functions) and pre-calculus concepts			12g
Data collection and analysis		10i	12h
Probability		10j	12i
Statistics (e.g., hypothesis tests, curve fitting and regression)			12j
Topics from discrete mathematics (e.g., combinatorics, graph theory, recursion)			12k
Mathematical structures (e.g., vector spaces; groups, rings, fields)			12l
Calculus			12m
Technology (calculators, computers) in support of mathematics		10k	12n
Reliability (Cronbach's Coefficient Alpha)	**0.91**	**0.86**	**0.91**

Composite T4: 6–12 Science† Content Preparedness	Bio/ Life Sci	Earth Sci	Env Sci	Chem	Physics	Phys Sci	Integ Sci	Tech
Earth's features and physical processes		13a1	13a1			13a1	13a1	
The solar system and universe		13a2				13a2	13a2	
Climate and weather		13a3	13a3			13a3	13a3	
Structure and function of human systems	13b1						13b1	
Plant biology	13b2						13b2	
Animal behavior	13b3						13b3	
Interactions of living things/ecology	13b4		13b4				13b4	
Genetics and evolution	13b5						13b5	
Structure of matter and chemical bonding				13c1		13c1	13c1	
Properties and states of matter				13c2		13c2	13c2	
Chemical reactions				13c3		13c3	13c3	
Energy and chemical change				13c4		13c4	13c4	
Forces and motion					13d1	13d1	13d1	13d1
Energy					13d2	13d2	13d2	13d2
Light and sound					13d3	13d3	13d3	13d3
Electricity and magnetism					13d4	13d4	13d4	13d4
Modern physics (e.g., special relativity)					13d5	13d5	13d5	
Pollution, acid rain, global warming			13e1				13e1	
Population, food supply and production			13e2				13e2	
Formulating hypotheses, drawing conclusions, making generalizations	13f1	13f1	13f1	13f1	13f1	13f1	13f1	13f1
Experimental design	13f2	13f2	13f2	13f2	13f2	13f2	13f2	13f2
Describing, graphing, and interpreting data	13f3	13f3	13f3	13f3	13f3	13f3	13f3	13f3
Reliability (Cronbach's Coefficient Alpha)	**0.93**	**0.86**	**0.86**	**0.77**	**0.85**	**0.94**	**0.92**	**0.90**

† This composite was computed for each teacher based upon the subject of his or her first science class of the day. Because the number of teachers in any specific content area may be low within a project, project results are combined into one content composite.

Composite T5: Traditional Practices	**K–8 Science**	**K–8 Math**	**6–12 Math**	**6–12 Science**
Assign science/mathematics homework.	21n	20m	19m	19n
Answer textbook/worksheet questions	22g			20g
Practice routine computations/algorithms.		21g	20g	
Review homework/worksheet assignments.	22h	21h	20h	20h
Take short-answer tests (e.g., multiple choice, true/false, fill-in-the-blank).	22x	21z	20z	20y
Reliability (Cronbach's Coefficient Alpha)	**0.81**	**0.71**	**0.47**	**0.69**

Composite T6: Investigative Culture	**K–8 Science**	**K–8 Math**	**6–12 Math**	**6–12 Science**
Arrange seating to facilitate student discussion.	21e	20c	19c	19e
Use open-ended questions.	21f	20d	19d	19f
Require students to supply evidence to support their claims. †	21g			19g
Require students to explain their reasoning when giving an answer. †		20e	19e	
Encourage students to explain concepts to one another. †	21h			19h
Encourage students to communicate mathematically†		20f	19f	
Encourage students to consider alternative explanations. †	21i			19i
Encourage students to explore alternative methods for solutions. †		20g	19g	
Participate in discussions with the teacher to further science/mathematical understanding.	22b	21b	20b	20b
Work in cooperative learning groups.	22c	21c	20c	20c
Share ideas or solve problems with each other in small groups.	22j	21k	20k	20j
Reliability (Cronbach's Coefficient Alpha)	**0.89**	**0.87**	**0.84**	**0.83**

† The mathematics and science versions of this question are considered equivalent, worded appropriately for that discipline.

Composite T7: Investigative Practices	**K–8 Science**	**K–8 Math**	**6–12 Math**	**6–12 Science**
Make formal presentations to the class.	22d	21d	20d	20d
Engage in hands-on science/mathematical activities.	22k	21l	20l	20k
Design or implement their own investigation.	22m	21o	20o	20m
Work on models or simulations.	22o	21p	20p	20o
Work on extended science/mathematics investigations or projects (a week or more in duration).	22p	21q	20q	20p
Participate in field work.	22q	21r	20r	20q
Write reflections in a notebook or journal.	22s	21u	20u	20s
Work on portfolios.	22w	21y	20y	20x
Reliability (Cronbach's Coefficient Alpha)	**0.83**	**0.84**	**0.85**	**0.80**

Composite T9: Principal Support	**K–8 Science**	**K–8 Math**	**6–12 Math**	**6–12 Science**
My principal encourages me to select science/mathematics content and instructional strategies that address individual students' learning.	8a	8a	9a	9a
My principal accepts the noise that comes with an active classroom.	8b	8b	9b	9b
My principal encourages the implementation of current national standards in science/mathematics education.	8c	8c	9c	9c
My principal encourages innovative instructional practices.	8d	8d	9d	9d
My principal enhances the science/mathematics program by providing me with needed materials and equipment.	8e	8e	9e	9e
My principal provides time for teachers to meet and share ideas with one another.	8f	8f	9f	9f
My principal encourages me to observe exemplary science/mathematics teachers.	8g	8g	9g	9g
My principal encourages teachers to make connections across disciplines.	8h	8h	9h	9h
My principal acts as a buffer between teachers and external pressures (e.g., parents).	8i	8i	9i	9i
Reliability (Cronbach's Coefficient Alpha)	**0.89**	**0.89**	**0.87**	**0.89**

Composite T13: Participation in LSC	**K–8 Science**	**K–8 Math**	**6–12 Math**	**6–12 Science**
To what extent has participation in LSC mathematics/science-related professional development increased your: mathematics/science content knowledge.	27a	26a	25a	25a
To what extent has participation in LSC mathematics/science-related professional development increased your: Understanding of how children think about/learn mathematics/science.	27b	26b	25b	25b
To what extent has participation in LSC mathematics/science-related professional development increased your: Ability to implement high-quality mathematics/science instructional materials.	27c	26c	25c	25c
Reliability (Cronbach's Coefficient Alpha)	**0.91**	**0.93**	**0.89**	**0.90**