Executive Summary of the Final Report on the Evaluation of the National Science Foundation's Centers for Learning and Teaching Program

Prepared for:

The National Science Foundation
Directorate for Education and Human Resources
Division of Research, Evaluation, and Communication
and
Division of Elementary, Secondary, and Informal Education

Prepared by:

Abt Associates Inc.
55 Wheeler Street
Cambridge, MA 02138

and

SRI International
1100 Wilson Boulevard, Suite 2800
Arlington, VA 22209-3915

March 2005

Executive Summary of the Final Report on the Evaluation of the National Science Foundation's Centers for Learning and Teaching Program

Prepared under Contract:
REC9912174, B18491X

Jennifer Carney
Mary Ann Millsap
Deepika Chawla
Autumn Wiley
Abt Associates Inc.

James McCullough
Charles Storey
Susan H. Russell
SRI International

Prepared for The National Science Foundation
Directorate for Education and Human Resources
Division of Research, Evaluation, & Communication
and
Division of Elementary, Secondary, and Informal Education

March 2005

National Science Foundation, Division of Research, Evaluation and Communication, Evaluation of the CLT Program: Volume I, NSF 05-XXX, (Arlington, VA, 2005).

Executive Summary

This report describes the implementation of the National Science Foundation's (NSF) Centers for Learning and Teaching (CLT) program, from the program's beginning in Fiscal Year 2000 through the startup activities of its fourth cohort, in Fiscal Year 2003. It also presents Center participants' perceptions of the value added by the program's emphasis on institutional collaboration to achieve multiple goals.

The CLT program is designed to employ collaborative partnerships among doctoral-granting institutions, local education agencies, and other education organizations to address a range of short- and long-term issues in science, technology, engineering, and mathematics (STEM) education at the K-12 level. These issues include the retirement of higher education faculty who prepare educators, inadequate content knowledge among teachers, and the paucity of research on contemporary STEM education topics. Through such partnerships, each Center is expected to integrate its efforts toward three program-wide goals: [1]

- to renew and diversify the cadre of leaders in STEM education (typically through graduate education);
- to increase the number of K-12 educators capable of delivering high-quality STEM instruction and assessment (typically through professional development and, less so, through pre-service teacher training); and
- to conduct research into STEM education issues of national import (e.g., the nature of learning, teaching strategies, and reform policies and outcomes).

Each Center is awarded approximately $10 million over five years to implement its particular approaches to the three program goals.

In 2001 NSF contracted with Abt Associates Inc. and SRI International to evaluate the CLT program by assessing the 13 Centers funded in the four annual cohorts initially funded between 2000 and 2003.[2] SRI conducted site visits to all 13 Centers to interview participants and observe Center events. Abt Associates conducted multiple web-based surveys of the first 10 Centers funded, and surveyed non-CLT faculty members in a selected comparison group of schools of education. [3] This jointly-authored report is a synthesis of the findings across the two evaluations and concentrates on implementation—how Centers have organized themselves and the progress that Centers have made in addressing their goals. Centers have not yet had sufficient time to produce new doctorates, trace the effects of professional development into classrooms, nor conduct and publish research on contemporary STEM education issues.

---

1 CLT Program Solicitation, FY 2004, NSF 04-501.

2 Three more Centers were funded in 2004.

3 A third contractor, Westat, is responsible for an annual program monitoring system, a web-based collection system that collects standardized data across each center. Data from that system informs this report where appropriate.

In general, Abt and SRI found that the CLT program has demonstrated the value of its collaborative partnership model for expanding the national capacity for STEM education doctoral production, broadening doctoral students' educational experiences and professional networks, and attracting students who would not otherwise pursue the doctorate. The program has also stimulated the development of Center-wide research agendas exploring a range of contemporary STEM education research topics. There is some evidence that the greatest added value for collaboration resulting from the CLT program is in fostering cross-institutional collaborations among faculty members.

CLT Program Portfolio

The CLT program was intended to produce a portfolio of Centers having a variety of content foci, at the same time seeking disciplinary, institutional, urban/rural, and geographic balance. Exhibit 1 provides a brief description of the portfolio through the first four sets of awards.

The Centers are evenly distributed by content area: six focus on math, six on science, and one on both math and science. Among the science Centers, two focus on learning technologies for teaching science in middle and high school grades. The other four science Centers, each spanning grades K-12, include two capitalizing on the contributions of informal science institutions, such as museums, zoos, and botanical gardens; one targeting science curriculum materials, and one doing in-depth work on student assessment in science. The Center targeting both science and mathematics concentrates on high needs students in urban and rural settings.

All math Centers span grades K-12. Two focus on mathematics in urban settings (one as a prototype virtual center), another explores issues in rural settings, two Centers are concerned with issues of diversity and equity in mathematics (one being the science and math Center listed above), one targets math curriculum materials, and one concentrates on proficiency in teaching mathematics.

Exhibit 1

Centers for Learning and Teaching, Their Partner Institutions and Overall Focus, by Cohort and Initial Funding Year

Cohort 1 (2000)	Partner Institutions	Overall Focus
Information Technology in Science Center for Teaching and Learning (ITS)	Texas A&M University*, University of Texas Dana Center, Fort Worth Museum of Science and History	New learning technologies for teaching science in grades 7 through 12
Mid-Atlantic Center for Mathematics Teaching and Learning (MAC-MTL)	University of Delaware, University of Maryland*, The Pennsylvania State University, Delaware State Department of Education, Pittsburgh Public Schools (PA), Prince George's County Public Schools (MD)	Prototype virtual Center focusing on K-12 mathematics in urban settings
Cohort 2 (2001)		
The Appalachian Collaborative Center for Learning, Assessment, and Instruction in Mathematics (ACCLAIM)	Marshall University, Ohio University, University of Kentucky, University of Louisville, University of Tennessee*, West Virginia University	K-12 mathematics education in rural settings
Center for Assessment and Evaluation of Student Learning (CAESL)	University of California- Berkeley, CRESST/University of California- Los Angeles, Stanford University, WestEd*, Lawrence Hall of Science	Assessment of K-12 student performance
Center for Informal Learning and Schools (CILS)	University of California- Santa Cruz*, King's College-London, The Exploratorium	Informal science education for grades K-12

Exhibit 1

Centers for Learning and Teaching, Their Partner Institutions and Overall Focus, by Cohort and Initial Funding Year

Center for Learning and Teaching in the West (CLT-West)	Colorado State University, Montana State University*, Portland State University, University of Montana, University of Northern Colorado, Portland Public Schools (OR)	Science and mathematics for K-12 high-needs students in urban and rural settings
The Diversity in Mathematics Education Center for Learning and Teaching (DiME)	University of California- Berkeley, University of California- Los Angeles, University of Wisconsin-Madison*, Berkeley Unified School District, California Subject Matter Project, Madison Metropolitan School District (WI)	Issues of diversity and equity in K-12 mathematics education
Cohort 3 (2002)		
St. Louis Center for Inquiry in Science Teaching and Learning (CISTL)	St. Louis Community College, University of Missouri-St. Louis, Washington University- St. Louis*, Association of Science-Technology Centers (ASTC) (DC), Kirkwood R-7 School District, Maplewood-Richmond Heights School District (MO), Missouri Botanical Garden, School District of Riverview Gardens (MO), School District of University City (MO), St. Louis Public Schools (MO), St. Louis Science Center, St. Louis Zoological Park, Tyson Research Center at Washington University	Formal and informal science education for K-12 students in urban settings
Center for Curriculum Materials in Science (CCMS)	Michigan State University- Lansing, University of Michigan, American Association for Advancement of Science (DC)*, Chicago Public Schools (IL), Detroit public schools (MI), Lansing School District (MI)	K-12 science curriculum materials
Center for Proficiency in Teaching Mathematics (CPTM)	University of Georgia- Athens, University of Michigan - Ann Arbor, University of Michigan-Dearborn, University of Michigan- Board of Regents, City of Social Circle (GA), Counties of Morgan and Gwinett (GA), Oakland School District (GA), South Redford School District (GA), Oakland Intermediate School District (MI), South Redford School District (MI)	Professional development of K-12 mathematics teacher educators
Cohort 4 (2003)		
Center for the Study of Mathematics Curriculum (CSMC)	Michigan State University, University of Missouri, University of Missouri- Columbia*, Western Michigan University, Columbia Public Schools (MO), Horizon Research, Inc., Kalamazoo Public Schools (MI), Battle Creek Public Schools (MI), University of Chicago School Mathematics Project Group	K-12 mathematics curriculum
MetroMath: The Center for Mathematics in America's Cities (MetroMath)	The City University of New York, Lincoln University, Rutgers University- New Brunswick*, The University of Pennsylvania, University of Pittsburgh LRDC, The State University of New Jersey, Local school districts in New York City, Newark, Plainfield and Philadelphia, Bank Street College of Education, Education Works, The Merck Institute for Science Education.	K-12 mathematics education in urban settings

Exhibit 1

Centers for Learning and Teaching, Their Partner Institutions and Overall Focus, by Cohort and Initial Funding Year

Technology-Enhanced Learning in Science Center (TELS)	Arizona State University, Boston University, Mills College, Norfolk State University, North Carolina Central University, The Pennsylvania State University, University of California at Berkeley*, Cambridge Public Schools (MA), The Concord Consortium, Berkeley Public Schools (CA), Mount Diablo Public Schools (CA), The Technion Institute of Technology, Tempe Public Schools (PA), Maynard Public Schools (MA).	Use of technology to enhance science education in grades 6 through 12

Sources: Project web sites, site visit notes, materials for 2004 CLT PI meeting held in Washington D.C., CLTNet

* Official NSF Grantee

Center Organization, Collaborative Activities, and Participants

In keeping with the program requirements that Centers employ collaborative partnerships, Centers typically have between three and seven partner institutions, with Institutions of Higher Education (IHEs) serving as the grantee of record in 10 of the 13 Centers. Decisions about cross-Center policies and activities are typically made by management teams (an inner ring of core partners), comprised principally of IHE partner institutions. In three Centers (CISTL, CILS, and CAESL), informal science institutions (ISIs) are members of the management team, and in one of them (CILS) the ISI is the grantee of record. With few exceptions, schools and school districts are not usually members of the management team, but rather are connected to the Center through their relationships with a single IHE partner.

Of the three NSF goals for the CLT program, Centers have focused more on graduate education and professional development than on research. In CLT, 260 students are pursuing doctorates, and almost 1,000 educators received CLT professional development in the last academic year. Center-wide activity is mostly found in doctoral education, with professional development and research typically being separate efforts of each partner. Most faculty are part of the Center because their interests coincide more or less with the Center agenda, so their interests and the Center's agenda are not mutually exclusive.

Notable Center-wide graduate education endeavors include ACCLAIM's entirely new doctoral education program in math education with an emphasis on teaching math in rural settings. Spanning five IHEs, a strong point of the program is the distance learning format, allowing students to keep their regular full-time jobs. In the CLT-West program, 15 courses (12 of which are new) are shared among the Center campuses and taught on-line, also a plus for students already employed or unable to move to campus because of familial obligations. Collaborative courses are also a TELS centerpiece. While DiME doctoral students take most courses on their individual campuses, they participate in cross-campus research groups that meet regularly via conference calls and collaborate on shared questions of diversity in mathematics.

Most professional development is provided by individual partners within the Centers, although partner institutions within four Centers have provided professional development jointly. The CPTM Summer Institute of 2004 was an elaborate, nine-day undertaking for professional developers across the nation that involved faculty and students from two IHEs, and resulted in a graduate-level course that will be jointly taught on both campuses. TELS partners are providing joint professional

development to teachers, helping them design curricular units for an emergent form of educational software. CISTL's professional development offers a hybrid of joint and individual institutions' efforts, including summer internships at CISTL's informal science institution partners that are coordinated and supervised by a group of CISTL liaisons. MetroMath offers a summer program for mathematics teacher leaders at five locations simultaneously.

In five Centers, sizable numbers of STEM faculty have become engaged in math and science education, another NSF goal for this program. Two Centers (ITS and CLT-West) account for about three-fifths of all CLT STEM faculty. In these two Centers plus three others, STEM and Education faculty report substantial interaction, with at least one-quarter (and up to 40 percent) of their interactions being across disciplines. The amount of interaction is noteworthy, especially given historical cultural differences between education and disciplinary faculty.

Centers are beginning to have an impact within their partner institutions. Partner institutions report that as a result of the CLT more Education and STEM faculty members are becoming engaged in STEM education research. Half of the IHE partners report that more faculty in their School of Education are pursuing STEM research, and just over one-third of the IHEs report that more faculty in disciplinary departments are pursuing STEM education research, even though publications in STEM education are not valued as much as disciplinary research in STEM departments.

Most Centers have also stimulated faculty hiring in STEM education. Eight Centers have gained faculty lines in Schools of Education for new hires in STEM education, while five Centers have gained faculty lines in STEM departments. MAC-MTL is a leader in faculty hires. In its first three years, eight new math education faculty members were hired across its three IHEs, principally for doctoral program expansion.

Graduate Education

All Centers are involved in graduate education, and most Centers have multiple university partners with CLT-related doctoral programs. Of the ten Centers in the first three cohorts, three have adopted entirely new degree programs, two have developed new degree concentrations for students earning a STEM education doctoral degree, and the other five Centers have substantially modified existing degree programs.

In the early start-up years, Centers often recruit their doctoral students from those already enrolled; the longer the Centers operate, the more likely they are to recruit students from multiple sources. At the mid-point of the CLT Program, half of the doctoral students were already enrolled in their graduate programs when they joined the CLT program. About 40 percent of CLT doctoral students had either taught in K-12 settings or worked in a school district prior to starting graduate school, and one-third of CLT graduate students report that they would not have attended graduate school without the CLT program. The extent to which Centers are effectively replenishing the cadre of leaders is as yet unknown, because two-thirds of the doctoral students report that they are still taking courses and have not yet begun their doctoral research. Nevertheless, these students clearly are strongly influenced by their Center's focus, most plan to conduct research and evaluation and/or teach in higher education when they complete their studies, and they will enter the work force earlier than students recruited without prior graduate education experience.

When surveyed, nine out of ten CLT doctoral students indicated that they believe that being part of a collaborative center that includes multiple institutions has value over and above other single institution graduate programs, and they cite as an important benefit of their CLT participation the development of a broader professional community than they would have developed on their campus alone. Seven out of ten CLT doctoral students also report that they have more opportunities to interact with faculty and students at other institutions than their non-CLT peers. Moreover, faculty who teach both CLT and non-CLT students rate CLT students as better prepared in multiple areas, including conducting research in STEM education and understanding how to connect research with classroom practice.

Common challenges in doctoral education have been coordinating course approvals, academic schedules, faculty schedules, and so on across Center IHEs, along with using distance-learning technology effectively. Also, no Centers have been entirely successful in recruiting students from underrepresented groups. Even among the three Centers that focus specifically on recruiting underrepresented minorities (DiME, CILS, and CLT-West), success has been mixed. Some CLT faculty members believe that there is a lack of qualified applicants within their informal recruiting networks. For some schools, the lack of success is due in part to their geographic settings, which are distant from significant minority populations and are considered undesirable by some potential minority applicants. Some faculty have talked about actively recruiting from predominantly minority schools, but to date this has happened infrequently.

Professional Development

The Centers have been engaged in a substantial amount of professional development. Most professional development provided by the Centers is an autonomous undertaking of individual Center partners. In four cases, two or more institutions within a Center collaborate in providing professional development. Whether coordinated across institutions or not, three-fourths of faculty involved in CLT professional development noted that they have been able to begin new professional development activities that they would not have undertaken otherwise. In 2003-2004, 923 teachers or other educators received professional development; one third received more than 60 hours each.

Ten Centers have made in-service teachers the primary target of professional development efforts, while two Centers focus primarily on professional developers themselves and one Center serves ISI educators exclusively. Many Centers include district and school administrators in their professional development, even though not all of them have made administrators a primary target. Topics of CLT professional development vary according to Center themes. Together the Centers are addressing a wide range of topics in line with the CLT program goals.

Centers have confronted several problems in providing professional development. The salient problems include inadequate publicity about some components; school district politics that undermine efforts; in-service teachers' difficulties in keeping up with associated graduate school level coursework; in-service teachers' discomfort with distance learning technologies; and a gap between the technology needed to implement some lessons and the technology that is actually available in some in-service teachers' home districts.

Research Activities

All Centers report that they are involved in research, and research topics mirror the programmatic emphasis of the Centers. In general[4] the CLT program did not provide funding to support faculty research, thus most CLT research is undertaken by graduate students with faculty guidance. Faculty members typically have continued their pre-Center research efforts, albeit sometimes with new emphases that more closely reflect the Center's focus. Some faculty members also have previous time commitments or have already created research agendas that they are reluctant to alter. Given that doctoral students are engaged in most of the research, it will likely be several years before CLT research makes its way onto a national stage.

Program emphasis on research has evolved over time. When the first Cohort of Centers was funded four years ago, research was not required. For later funded Centers, defining Center-specific research questions has taken far longer and been a far more difficult undertaking than the Centers imagined.

In some Centers, there is also tension between Education faculty and STEM faculty with regard to what qualifies as "research" and the value of qualitative versus quantitative research. There is also tension between IHE faculty and school personnel/informal educators regarding the perceived value of applied versus more theoretical research. IHE faculty usually are most interested in research that will add to the knowledge base in their field, whereas school district and informal education personnel are more interested in research that they can apply directly to their activities.

More than 80 percent of CLT doctoral students noted that more opportunities to participate in research was one of the key benefits of being in a collaborative Center. Similarly, 80 percent of the faculty involved in CLT research noted that they have been able to undertake new topics of research in STEM education that they would not have undertaken otherwise.

Continuing Center-wide Opportunities and Challenges

Overall, the major, primary benefit of CLT participation for both students and faculty is exposure to individuals in other disciplines and from other partner institutions. CLTs have pulled together people in different roles and settings, creating a varied environment from which participants report learning. The focus here is more on general networking (becoming aware of other perspectives and possibilities) than it is on joint collaboration, though collaboration does take place. Among faculty who cited collaboration as a motivation for joining the CLT, 92 percent[5] have been able to work with colleagues in other institutions, and 80 percent have been able to work more with colleagues at their institution but in other departments. This program benefit is likely to have the greatest effect in the long run with the CLT graduate students, who have been exposed to other ideas, perspectives, and people, and whose own perspectives are shaped as a result.

Coordinating across multiple institutions—with different cultures, administrative structures, and schedules—is inherently complex and difficult. For example, establishing a system through which students receive academic credit for courses taught by other institutions has been a challenge for several Centers. Some Centers have struggled to accommodate different academic calendars. Setting

[4] CAESL was awarded a supplemental research grant to investigate methods of assessing students' learning.

[5] Reporting the percent of faculty who selected either "Agree" or "Agree Somewhat" to relevant survey items.

up administrative systems to handle the allocation of grant funds has been extremely time-consuming for many Centers. And many management team members have talked about the difficulty of scheduling teleconferences, let alone in-person meetings, with the Center's many partners. In the end, coordinating CLT activities has turned out to require much more time than Center leaders initially envisioned. Some of these difficulties, such as cross-campus academic credit and grant-management systems, have been resolved. Others, such as different academic calendars and scheduling meetings, are ongoing issues.

Technology is indispensable to Center-wide operations. Distance learning technology, the Internet, telecommunications, and video conferencing technologies have enabled CLT partner institutions to send materials to participants in multiple locations, teach courses across campuses, teach courses simultaneously, and hold seminars. At the same time, several Centers have struggled with such issues as sufficient bandwidth, use of visual aids, feedback, and interaction through a video screen. In other Centers, some participants had limited access to technology. Over time, CLTs are becoming more comfortable with the use of technology. In addition, advances in technology, greater bandwidths, sending out materials in advance of videoconferences, and electronic feedback have helped make courses a better experience.

By far, CLTs' largest challenge is simply dealing with the broad CLT agenda. Centers are expected to have simultaneous, coordinated activities in their graduate programs, their research, and their professional development activities. Ideally, all partners interact with all other partners on all activities. Centers are also expected to interact with other Centers and with the rest of the education and STEM community to prove that their Center has a national focus. At this point in the program's development Centers are primarily focused on designing and implementing activities. Assessment of the program's success must ultimately wait until the Centers complete their grants, but as each Center finds its niche and defines its agenda, collectively the Centers are progressing towards achieving the CLT program's goals.