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ABSTRACT

Connecticut was in the first round of states to be awarded an $8.6 million grant by the National Science Foundation for 5 years to change its system of education for improved teaching and learning in mathematics, science, and technology, with emphasis on improving the achievement of poor and minority children. A private firm evaluated this Statewide Systemic Initiative annually over the 5 years, focusing on four of its components: (1) creating change through the Connecticut Academy for Education in Mathematics, Science, and Technology; (2) forming higher education partnerships for elementary and secondary education; (3) creating change through science-rich institutions, schools, the family, and community; and (4) the campaign for public understanding. This evaluation effort did not focus on the program's component for enlivening mathematics and science learning and student assessment. Evaluation involved study of the program background, participants, objectives, operations, decision-making processes, and outcomes. It is concluded that Project CONNSTRUCT is a highly successful statewide systemic initiative. Key participants, major stakeholders, general participants, and a number of citizens of Connecticut and other states think it has met its objectives well, and it is seen by a broad constituency as a genuine advocate and broker for educational change in mathematics, science, and technology. Shortcomings were noted in the improvement of the achievement of poor and minority children and in the systemic reform of higher education. Challenges for the next 5 years are introduced. (SLD)

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Connecticut Academy for Education in Mathematics, Science, and Technology

Project CONNSTRUCT

1991 to 1996

SUMMATIVE EVALUATION

September 1996

by

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Abstract

This is a summative evaluation of Project CONNSTRUCT, a Statewide Systemic Initiative. Connecticut was in the first round of states to be awarded an $8.6 million grant by the National Science Foundation for five years in order to change its system of education for improved teaching and learning in the areas of mathematics, science, and technology, with special emphasis on improving the achievement of poor and minority children. CONNSTRUCT consists of these five interrelated components—Component One: creating avenues for change through the Connecticut Academy for Education in Mathematics, Science, and Technology; Component Two: enlivening K-12 mathematics and science learning and assessing of student progress; Component Three: higher education partnerships for K-12 education; Component Four: creating an environment for change through science-rich institutions, business and industry, schools, and family and community (refocused on instructional technology); and Component Five: campaign for public understanding. This evaluation effort did not focus on Component Two.

During the course of the five years, Curriculum Research and Evaluation completed formative evaluations on an annual basis in cooperation with the State Department of Education. The State Department of Education had responsibility for development and evaluation of Component Two. The firms' formative and summative evaluations emphasized qualitative methods of data collection and analysis (namely—observation, interview, and document collection) to capture the story of CONNSTRUCT's development and to report on its successes and failures or shortcomings. In an effort to describe and explain what occurred in this federally funded project, the firm focused attention on historical background, influential persons, stakeholders, goals, objectives, operations, decision-making processes, changes, issues or problems, products, and recommendations for evaluation from NSF.

The conclusion is: Project CONNSTRUCT is a highly successful statewide systemic initiative. Data show that key participants in this project, major stakeholders, general participants, and a significant number of citizens in other states as well as in Connecticut judge this project as having met its objectives at a very high level of accomplishment. Most of all, CONNSTRUCT is seen by a broad constituency as a genuine advocate and broker for the systemic reform of education in mathematics, science, and technology in the state. Participants describe Academy executives as the "blue suits," who really can convince the "blue suites" of business and industry, government, and education that continuing their support for CONNSTRUCT's innovative programs and its overarching goal of systemic

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reform is vital for the improvement of teaching and learning in Connecticut.

CONNSTRUCT has shortcomings in two areas—the significant improvement of poor and minority children's achievement in mathematics and science and the systemic reform of higher education. These are educational problems of great magnitude nationally. The Academy's executive officers and other key participants and stakeholders, such as the State's Commissioner of Education and Commissioner of Higher Education, acknowledge the magnitude of solving these problems nationally and readily admit the shortcomings of this project. They report that, thus far, there has been "incremental," not significant, progress in either area and that both institutions suffer from bureaucracy and intransigence. However, the Academy has every intention of improving this record in the near future and has executed plans to do so.

Outstanding qualities of the Academy are: broadly-based membership, collaborative decision making, preference to set clear goals and objectives well in advance of the execution of plans, pursuit of objectives to full completion, revision of plans in the light of difficulties, reliance on the very best human resources in the state and nation, strong commitment to the project by all key players, commonly understood history of accomplishments, and commonly held vision of systemic reform. CONNSTRUCT has introduced a unique way of solving the problems of educating the State's children in mathematics, science, and technology. Important key methods include: assessment tied to high standards in curriculum and instruction for professional teaching and a heightened conception of learning for all children; partnerships between government, business and industry, and education to create an equitable system of education; effective use of highly qualified, dedicated people; restructuring of teacher education and professional development programs; grass-roots work with parents; and the ongoing effort to restructure the institutions of K-12 and higher education, so that they are more flexible, modern, and humane for the educators who work there as well as for the citizens who depend on them for education.

CONNSTRUCT's challenges in the next five years are: (1) to produce significant improvement in students' achievement in mathematics and science, especially among children in the urban centers, and (2) to restructure and realign the State's systems of K-12 and higher education, so that they are recognized as truly different—vital and productive—modern institutions.

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Connecticut Academy for Education in Mathematics, Science, and Technology

Project CONNSTRUCT

SUMMATIVE EVALUATION
1991 to 1996

1. Introduction

Systemic Change

- *"To bring about the changes needed in mathematics and science instruction, the current education system must be changed in a systemic manner based on clear standards of what children should learn. State policy makers should take the lead in bringing about that change."*

- *"Because of the interconnectedness of standards, curriculum teacher preparation, the development of instructional materials, and assessment, systemic change must come to mean the coordinated reform of all these components—in all their dimensions—simultaneously."*[1]

Project CONNSTRUCT is Connecticut's Statewide Systemic Initiative (SSI) which was established in 1991 with a five year, $8.6 million grant from the National Science Foundation (NSF). The Connecticut Academy for Education in Mathematics, Science, and Technology is the nonprofit agency established in 1992 for the purpose of implementing the project's goals.[2] The main purpose of CONNSTRUCT is to collaborate with business, industry, labor

[1] *Improving Math and Science Teaching: A Report on the Secretary's Second Conference on Mathematics and Science*. Office of Educational Research and Improvement, U.S. Department of Education, 1993.

[2] The terms used to refer to this project, including Connecticut Academy, Academy, Project CONNSTRUCT, and CONNSTRUCT, are used interchangeably.

groups, government, educational institutions, and community organizations to focus the State's resources on implementing long-term reform in the teaching and learning of mathematics, science, and technology. This is the external evaluator's report of Project CONNSTRUCT's accomplishments during the five years of its history, from 1991 to 1996.

There are five different, interrelated components in CONNSTRUCT, which are focused on management, systemic implementation support, higher education, instructional technology, and public awareness/community outreach. Continuity in leadership and commitment to service are key features in the management and operations of the Connecticut Academy for Education. Governance of the project is provided by a Board of Directors made up of 37 members who represent different partners in this systemic initiative, including business and industry, state government, education, media, distinguished scientists, community organizations, and parent organizations. Eunice Groark, former Lieutenant Governor of the State of Connecticut, is President of the Academy; Chuck Bruce, IBM, Vice President; Glenn Cassis, CPEP, Secretary; and Ann Pollina, teacher, Treasurer. Richard Cole, formerly with The United Technologies Corporation, is Executive Director of the Academy. Mary Keeney is Director of Public Engagement. Robert Rosenbaum, Emeritus Professor of Mathematics at Wesleyan University, is Immediate Past President of the Academy. The other members of the Academy staff are: Heidi Weis, Secretary (part-time); Nancy Wogman, former Director of Administration and Programs (recently took a position elsewhere); Terri Clark, Director of Administration and Programs; and Lisa Vrobel, Program Assistant. There are also a bookkeeper and two student interns.

During these five years, there has been very little turnover at the Academy. During the fifth year, the election of a new president, as required by the organization's Bylaws, was executed smoothly in accordance with the Bylaws. The official headquarters of the Connecticut Academy for Education remains in the Academy House, which is on the campus of Wesleyan University at 178 Cross Street, Middletown, Connecticut 06457.

Day-to-day management of Project CONNSTRUCT is the copurview of the Academy and the Connecticut State Department of Education. During the past two years, German Bermudez has served as Project Director. His predecessors, who served approximately one year each, were Judy Carson and Susan Binkowski. Steven Leinwand and Mari Muri continue as the State's math consultants. In 1993, Steven Weinberg took over for Sig Abeles as science consultant for the State. The evaluation consultancy for the State has been the responsibility of Douglas Rindone, the State Department of Education Bureau Chief for Evaluation and Student Assessment. During the five years, there have been three Division of Curriculum and Instruction Bureau Chiefs, three Commissioners of Education and three Governors. The turnover at the State Department of Education has required reorientation efforts by the Academy. Yet, with all of this change, CONNSTRUCT has maintained its focus on the original goals, revised its objectives to meet emerging needs, and adapted its evaluation plan to meet NSF's requirements.

During the third and fourth years, Component Four, which originally focused on science-rich institutions, was refocused on instructional technology, plus a concern for partnerships among all of the technology organizations in the State. The science museums realized success at obtaining revenue for educational programs from sources outside of CONNSTRUCT. Thus, the Academy redirected its resources to improving the State's use of technology for education in mathematics and science. Component Five was originally concerned with public awareness. The Academy recognized media limitations for project publicity and, therefore, added community outreach in order to enhance the efforts of cities and towns to improve their mathematics, science, and technology education. The following are Component Leaders: Component One: Eunice Groark and Richard Cole; Component Two: German Bermudez; Component Three: Tim Craine; Component Four: Richard Cole with assistance from Robert Gelbach; Component Five: Mary Keeney with assistance from Lisa Vrobel and Chuck Bruce.

Evaluation Design and Methodology

The purpose of this evaluation is to assess CONNSTRUCT's pursuit of the overarching goal of NSF's program for systemic school reform to improve learning which leads to high achievement in challenging science and mathematics courses by all students. The evaluation also addressed CONNSTRUCT's success at establishing NSF's fundamental elements and drivers for systemic change and the accomplishment of its main objectives.

NSF's fundamental elements of systemic reform are: instruction; curriculum; assessment; professional development; policy, leadership, governance, and management; and partnerships and public awareness. Its drivers for systemic change are: comprehensive standards-based curricula; coherent and consistent policies; convergence of all resources; broad-based support for program goals; accumulation of significant performance data; and improvement in student performance.

The main objectives of NSF's systemic school reform program are:

- Responsibility for establishment of high-quality, well-aligned curriculum, instruction, assessment, and professional development;
- Implementation of a comprehensive, standards-based curriculum;
- Responsibility for reducing the "achievement gap" between the students the system serves best and those historically under served;
- Contribution to development of a coherent, consistent set of policies to dramatically improve achievement among all students served by the system;
- Responsibility for the convergence of the usage of all resources that support science and

mathematics education;

- Contribution to broad-based support from parents, policy makers, business and industry, foundations, and other segments of the community for the goals and collective values of the program; and

- Responsibility for accumulation of a broad and deep array of evidence that the program is enhancing student achievement.

This evaluation has not focused on Component Two, which would discuss assessment of the project's impact on Connecticut's school districts. NSF is especially concerned about students' achievement in mathematics and science as measured across geographic regions, racial/ethnic groups, special and regular education classes, and both genders. Also of interest to NSF are records of enrollment in higher level math and science courses; success in math and science courses; high school graduation rates; applications and admission to post-secondary education; scores on measures of learning in mathematics and science; and interest in pursuing math, science, and technology-based careers—all of which are expected to show an increase attributable, at least in part, to CONNSTRUCT.

The Academy has been working with the Connecticut State Department of Education to organize data collection and analysis procedures that lead to an improved system for locating, accumulating, analyzing, and reporting on student performance and do not duplicate the efforts of either agency or impact negatively on students and teachers. The State Department of Education, specifically the Bureau of Assessment and Student Evaluation, is currently analyzing survey data on students' and teachers' perceptions of teaching and learning, enrollment patterns, and results of the Connecticut Mastery Test (CMT) and the Connecticut Academic Performance Test (CAPT) that are desegregated by race and gender.

The design for evaluation included planning, formative, and summative elements. Planning evaluation was a recurrent interest in assessing an understanding of CONNSTRUCT's goals, objectives, strategies, and time lines. The main concern on the part of the Academy and the external evaluator was to determine if appropriate steps were being taken to assure that appropriate conditions have been established for evaluation of the project. During the course of the five years, the principal evaluator was invited to participate in discussions concerned with different external evaluations sponsored by NSF as well as development of the Academy's external evaluation.

Formative evaluation assessed the ongoing activities of CONNSTRUCT to determine if the project was conducted as planned and the manner and extent to which the project was meeting its goals. Qualitative methods included observation of activities and events, such as formal and informal meetings, workshops, and conferences; participation in events, such as site visits from NSF and other evaluators; structured and non-structured interviews with key

participants; and collection of documents. Sustained, site-based interviews were conducted with all of the principal players associated with CONNSTRUCT to acquire testimonials—first-hand authentification of facts—as well as descriptive details of the project's operations. The list of persons interviewed included principal investigators, executive officers, Academy staff, State Department of Education officials, State Department of Higher Education officials, component leaders, grantees, and students. A collection of survey instruments was prepared to assess the effectiveness of CONNSTRUCT in accomplishing its systemic goals and component objectives across all of its constituencies throughout the history of the project, including Board of Directors, Component Two grantees from the 19 school districts, Academy Fellows, and State Department of Education curriculum consultants. Analysis of survey data relied on quantitative and qualitative methods.

Summative evaluation was used to assess CONNSTRUCT's overall success. The main question was, "What were the project's strengths and weaknesses, particularly, in reference to NSF's goal of systemic reform, which is to significantly improve learning that leads to high achievement in challenging science and mathematics courses by all students?" Additionally, there was a focus on NSF's six drivers. Finally, there was special attention given to these fundamental elements or cross-cutting variables, also established by NSF: equity, quality, scaling-up, and coordination and organization. Methods of data collection and analysis for the summative phase were the same as those in the formative phase, including survey instruments to assess perceptions of CONNSTRUCT's effectiveness among the range of participants. The surveys were mailed to 185 persons and the returns (31%) were representative across all groups for both phases.

Organization of the Report

This summative report is organized in the following manner. The report begins with a description of the setting for this project, a brief explanation of CONNSTRUCT, and an overview of its accomplishments. Subsequent divisions of the report discuss the results of the evaluation, with a focus on components one, three, four and five. At the end of the report, there is comment on CONNSTRUCT's accomplishments which are viewed in relation to NSF's goal of systemic school reform and its drivers and to the fundamental elements and variables of educational reform.

2. Connecticut in the 1980s and 1990s

Connecticut, nicknamed the Nutmeg State and the Constitution State, is a state of great

variety and high contrasts. Geographically, nearly 50% of its border is a picturesque south-facing coastline on the Long Island Sound. The northwestern upland includes the steep foothills of the Berkshire Mountains. The northeastern upland, affectionately called the "Quiet Corner," has rock-filled glacial deposits, swampy lowlands, and heavily forested hills. Inland regions vary considerably from fertile farmland to large forests. The Connecticut River, flowing southwestward from the Connecticut lakes in northern New Hampshire, cuts a wide swath through the State, dividing it roughly in half. Lesser rivers, streams, lakes, and ponds abound. Field, stream, and ocean present sports enthusiasts with a great diversity of wildlife and recreational pursuits.

Socially and economically, the State consists of 169 towns and 166 independent public school districts. The three largest cities are Bridgeport, Hartford, and New Haven. Somewhat smaller cities that share similar characteristics as the larger cities are Danbury, New Britain, New London, and Waterbury. Like elsewhere in the nation, Connecticut's cities are densely populated areas with a substantial number of people who are poor and people who are members of minority racial and ethnic groups. Connecticut has a 19 % minority population, and most of these people live in its metropolitan areas. Ninety-nine percent of the school districts have less than 5% percent minority students. Many of the cities are the new homes for the most recent immigrants from Asian, Eastern European, and Latin American countries. While 96 % of the State's residents live in 12 metropolitan regions, the truly disadvantaged are found in the city centers or urban core areas. They live in public housing projects and low rent apartments or houses. Three of the State's largest cities are among the nation's poorest cities. Children, ages one - four, constitute the second largest growing population—the 65 and older group is the fastest growing—and 20% of the State's infants are born in poverty. Improving the social and economic conditions of the State's truly disadvantaged urban population is greatly needed, particularly in view of the contrasts with living conditions elsewhere in the State.

Connecticut is the third smallest state in the nation after Rhode Island its New England neighbor to the east, and Delaware, a Middle Atlantic state. For its size it has a great number of independent, small towns and many suburbs. However, in spite of the portrayal of urban poverty presented above, census data show the citizens of this State are rated as having the highest per capita income and educational achievement in the nation. The income average is high because many people earn a good living in Connecticut. Some are wealthy. Along the "Gold Coast," the shoreline property running to New York City, and in many suburbs and rural areas, there is a substantial number of affluent citizens. Thus, the high personal income realized by many citizens of Connecticut is not evenly distributed geographically. Most of the people who live in the urban centers are poor, are members of minority ethnic and racial groups, and are undereducated. To use one relevant index for assessment of earnings, Connecticut's average annual salary for teachers—the highest in the country, excluding Alaska and Hawaii—was $51,196 in the 1993-94 school year. The national average for the

same period was $36,846.

The State of Connecticut has approximately 508,000 children in school of which 52% are male and 48% are female. The student population is 73.3% Caucasian, 13% Black, 11.1% Hispanic, 2.4% Asian or Pacific Islander, and .02% American Indian or Alaskan Native. There are 35,000 teachers, 975 schools, and 30,000 classrooms throughout the 166 independent local school districts. The State's total education budget for 1995-96 was $1.31 billion and that was the largest item in the overall budget. The State Legislature provides approximately 35% of the finances for public schooling in Connecticut. Through property taxes, local communities supply 62% of the money for public schooling, and they exercise most of the authority for decision making. The federal government provides the remaining 3%. Urban school districts receive more state aid than wealthier school districts. Connecticut's per pupil expenditures, including local, state, and federal sources, averaged $7,433 in 1990-91 and was increased to $8,013 in 1993-94. In 1990-91 (the only period for which such data are available), Connecticut's expenditures per capita for elementary and secondary education were 23.7%, slightly lower than the national average of 24.1% for the same year.[3]

The State's booming economy had for decades been dependent on, and profitably associated with, the nation's military defense and aviation industries. Numerous subsidiary and subcontracting companies were linked to the major corporations in the State. Connecticut is also home to some of the largest insurance conglomerates in the nation. However, since the 1980s when the Cold War period came to an end, economic recession wracked the region, and high technology signaled the dawn of a new age for all workers. Connecticut's economy went bust almost overnight. Suddenly, many businesses and industries restructured their organizations, shrunk their workforces, closed up shops, or relocated to other areas of the country. Thousands of blue-collar and white-collar jobs were lost, and many thousands of people were either laid off for long periods of time or lost their jobs. Thousands more moved out of the State, permanently, in search of employment and career opportunities elsewhere.

3. Project CONNSTRUCT

CONNSTRUCT's main claims for establishing the statewide systemic initiative in

[3]Sources for data include the *Digest of Education Statistics: 1995*. U.S. Department of Education, Office of Educational Research and Improvement; and reports from the Connecticut Academy.

Connecticut in 1991 grew out of the deep-felt concern of many citizens—including leaders in government, business and industry, and education—that something substantive needed to be done to improve the State's educational program in mathematics, science, and technology. These visionary people saw that the improvement of education generally, and especially in these critical content areas, was absolutely essential for advancing the social and economic life chances of the State's poorest citizens. Also, throughout their careers, these men and women had been on the cutting edge of the knowledge explosion in mathematics, science, and technology and of the development of national standards for education in these areas. They knew that the time for systemic reform of education, in addition to being long overdue, would crash into everyone's consciousness in less than a decade. The State's life (on cultural, social, and economic terms) was at stake.

The official statement of CONNSTRUCT's mission and objectives for accomplishing the goal of statewide systemic reform appears below:

> *"CONNSTRUCT's five-year mission is to increase the number of students who take and master mathematics, science, and technical education subjects in grades K-12, utilizing all the resources available in Connecticut; to increase the effectiveness of teacher preparation and professional development programs; and to increase the public's awareness of today's need for the mastery of mathematics, science, and technology for all citizens."*

To accomplish the goal of statewide systemic reform, CONNSTRUCT would do the following:

> *"Establish a broadly-based cooperative program with the State Department of Education, local education agencies, institutions of higher education, science-rich institutions, state and federal agencies, and business, community, and media organizations. CONNSTRUCT's objective is to implement long-term reform in the way mathematics, science, and technical education take place, with special concern for minority students."*

Hence, the focus of the project would be on the neediest districts, also called priority school districts. CONNSTRUCT's five different components were designed to accomplish its stated goal. Component One is the Connecticut Academy for Education which would be a statewide advocate for significantly improving the State's educational program, leading eventually to higher achievement for all children in mathematics and science. Component Two is focused on improving teaching and learning in the congeries of local school districts, especially the 19 most needy, and the State Department of Education. Component Three is concerned with improving higher education, having a dual focus on preservice and inservice education of

teachers, and restructuring curricula of mathematics, science, and education in college departments to be consistent with the new standards, to be correlated with the K-12 curriculum, and to be less isolated and more collaborative. Component Four is devoted to enhancing the State's use of resources for education, especially technological resources such as the Internet and telecommunications. Component Five addresses the need to inform the public about the importance of improving the children's education in mathematics, science, and technology.

4. CONNSTRUCT's Accomplishments: 1991-96

Thus far in its brief, five-year history, CONNSTRUCT has extended its reach well beyond its initial commitment. CONNSTRUCT started in its first year to provide direct services to five of the neediest school districts. It provided those services to five more in the second year and nine in the third year, for a total of 19 school districts that received direct services after three years. This service impacted 30% of the total number of students in Connecticut and 70% of the under represented students in the State throughout year four. In its fifth year, the project continued direct services to the 19 neediest districts and expanded its program to offer limited services to an additional 14 districts, bringing to 33 the total number of districts served in a direct way. In this past year, the Academy made a full accounting of outreach services of CONNSTRUCT and concluded that it has provided either direct or indirect services to 127 different school districts, thus, impacting 77% of Connecticut's independent public school districts.

According to an executive officer,

> *"The Academy did not set out to affect all students in the state, but rather those students who attended the 25-30 neediest school districts. CONNSTRUCT's plan is to spread eventually to all districts. The specific objectives of the 1990-91 proposal to NSF were met at the 85-90% level."*

While CONNSTRUCT cannot take sole credit for the changes in educational policy since 1991 in Connecticut, without CONNSTRUCT's assistance—its continual and broadly based brokering and advocacy—these changes would have occurred much more slowly and some might not have occurred at all. The most important components added to Connecticut's educational infrastructure during 1991-96 were: substantial improvement of the CMT, development and implementation of the CAPT, development and implementation of the State Collaborative for Assessment of Student Standards (SCASS), development and implementation (anticipated in the summer of 1996) of the curriculum frameworks, and adoption of the new science standards by all districts associated with CONNSTRUCT.

Recent data show that the State is realizing "incremental" improvement in student achievement in mathematics and science. Since 1986, there has been a steady increase in the number of students who are at or above the State goal for mathematics proficiency. In 1986 30% of the students scored at or above the State goal for mathematics proficiency. In 1990 the number increased to 43%, in 1993 to 48%, and in 1994 to 50%. For the 1991-92 academic year, the State's three largest public school districts showed eighth grade student

mathematics proficiency rates of 9%, 10%, and 10%. Data from the 1994-95 academic year reveal that the State's three largest school districts showed incremental increases in mathematics proficiency. Still, the educational reality in Connecticut (and elsewhere in the nation) is that student performance on the CMT—in particular the mathematics section—correlates to the socio-economic condition of the community where the school is located. For example, 1994 test data show that, in the thirteen affluent school districts of Connecticut, nearly 80% of the students were achieving the State's goal. The same data set shows that, in the three poorest school districts, 97% of the students did not achieve the State's goal. The results of all of the other school districts in the State are arrayed between these two extremes and correlate to the relative wealth of all school districts in the State.

The current 3.9 % decrease in the State's public high school graduates occurs mostly in the urban high schools. Connecticut's high school graduation rate of 83% is higher than the national average of 73.4%. Also, 72% of its high school graduates continue their education beyond the twelfth grade, with 55% attending four-year colleges, 16% attending two-year colleges, and 4% attending other schools. The remaining 18% choose to join the workforce immediately after graduation from high school.

CONNSTRUCT's work in the State's institutions of higher education was executed according to a three-year plan for the professional development of university professors and K-12 teachers. However, most of the influence on improvement was directed toward the university curricula, instructional practices, institutional relations with K-12 teachers, and intra- and inter-departmental faculty relations at the university. All fifteen institutions of higher education in Connecticut that have teacher preparation programs received requests for proposals to participate in CONNSTRUCT activities. The plan to implement systemic reform in the institutions of higher education began with dialogues among the professors and K-12 teachers, administrators, interested business leaders, scientists, and mathematicians. Then, in the second year, the Academy established co-teaching partnerships among college faculty and K-12 teachers where each participant joined the other person in their actual classroom and collaborated on responsibilities for planning and teaching. Also, during this time, the Academy sponsored grants to improve the use of educational technology and college degree programs in mathematics, science, and teacher education. In the third and fourth years, Component Three's emphasis was on the development and subsequent implementation of plans for restructuring the colleges' preservice teacher education programs, which were fostered and nurtured by the first year dialogues. Data show that the results of Component Three's operations are a mixture of highly successful and promising initiatives to restructure courses and whole degree programs in mathematics, science, and education in some institutions; in other institutions the complete absence or avoidance of the critical thinking, spirited collaboration, and commitment—and the courage—necessary to bring into existence a whole new culture of the professorate and the university for this age.

Component Four's focus was to improve the use of instructional technology. The five year effort in this area would embed technology in the learning process, not just add computers and components—like cd-ROMS and video equipment—to the classrooms. The equipment was seen as too vital, too short-lived, and far too expensive to be shut in the schools' closets and storage areas, as has been the case with innovative instructional materials so frequently in the past. The Academy established a working relationship with the State Department of Education to merge academic activities with technology education courses. It also continued its work with the Joint Committee on Educational Technology (JCET) to develop a statewide plan for implementation of instructional technology in every school district. Component Four assembled the State's professional organizations of mathematics and science teachers, administrators, and technology educators for their collaborative effort of professional development programs for the State's teachers, using the available technology. Finally, Component Four formed a new collaboration from existing technology networks and service providers statewide to write a NSF proposal, entitled Connecticut Virtual Education Network Effort (CONNVENE), to align 12 existing computer networks into the beginning of a statewide network.

The original design of this project has the principal subcontractor, the Connecticut Academy for Education in Mathematics, Science, and Technology, established by the State Legislature in 1992 as incorporated *in perpetuity* for the dual role of advocate and broker for educational reform. The Academy and Project CONNSTRUCT are perceived by the participants as inseparable and indivisible entities, with the simple qualification that the State Department of Education has been the main contractor. The list of principal investigators includes officials from the State Department of Education and executive officers of the Academy. The interaction and interdependency of these two corporate entities is so thorough that the different participants, especially the consultants from the State Department of Education who are principal investigators, confess that they cannot, no matter how hard they try, separate what they do for CONNSTRUCT from what they do in their official capacity as mathematics and science consultants for the State.

As of the 1996 election, the Academy Board of Directors has three groups of directors who are classified and staffed as follows. Group A has sixteen members, including teachers, other outstanding educators, an eminent mathematician, a scientist , and technologists. Group B has seven members, who are elected and appointed, which include a Governor's representative and representatives from community, parent, and civic organizations. Group C has fourteen members from business and industry, media, and science-rich institutions. There is a total of 39 directorships, permitted by the Academy's Bylaws, of which 37 are currently filled. The Bylaws provide for rotation, expiration of terms, and appointment of directors through regular elections and, thereby, give assurance that the membership is a fresh and vital core for the Academy's steerage. To illustrate, ten directorships were up for re-election in 1996. Three of these directorships ended a second term, two replaced resigned

positions, and four directorships that were inactive in 1995 were filled—two from group B, one from group C, and one from group A. The list of board members' affiliations reads like a roll call of the key players in the State's business, industry, government, and education establishments—IBM, Pfizer, Northeast Utilities SNET, AETNA, CBIA, CPTV, Channel 8, PIMMS, State Department of Education, Governor's office, Connecticut Education Association, CCSU, SCSU, Western Connecticut State University (WCSU), and so on. Indeed, most of them have national prominence. These men and women are described by the Academy as significant policy leaders, who represent their corporation or agency as a serious stakeholder and partner in the Academy's mission to improve education in mathematics, science, and technology. If there is any doubt about a commitment from a director, the Board of Directors takes action to improve the directorship or remove the member.

The list of participants which includes many persons in the education area—many of whom may also be classified as key players—is extensive, currently involving school teachers and administrators from 77% of the school districts in the State. So, for example, in CRE's efforts to select key participants for the survey instruments, it identified a total of 185 individuals. That list of individuals included 88 Academy Fellows, 41 past and presently serving Board of Directors members, 19 school district coordinators of CONNSTRUCT's projects, and 10 current and 25 past Component Three grantees.

The Academy's business plan emphasizes long-term partnerships; strategic, broadly-based planning; clarity of objectives; accountability for planned outcomes; collaborative problem solving, capitalizing on unanticipated consequences; and shared decision-making and shared ownership of results. Principal sources of funding include foundations, corporations, federal grants, Connecticut's State Legislature, and the Academy's services. The Academy's policy is to broker with potential investment partners from businesses and foundations to secure financial resources to satisfy both the investors' mission, improving educational programs, and the educators' interest in securing professional development, equipment, or instructional materials, providing a high quality learning environment for children in Connecticut.

5. Leadership of Component One: The Connecticut Academy for Education

In this section, Project CONNSTRUCT's success is discussed, with particular attention on the perspective of its leadership. Data included the responses to structured interview questions by six key CONNSTRUCT participants, a large collection of documents produced by the project, and reports from numerous observations of different official meetings and events. Participants for the interviews included executive officers of the Academy and principal investigators and curriculum consultants from the State Department of Education. Analysis of the participants' responses showed a very high level of agreement on all questions. Variation was either one person's minor deviation or disagreement in regard to what the others had said, or, more often, it was a qualification that added more depth to an already substantial data set. Analysis of print and nonprint documentation showed that CONNSTRUCT has a high level of internal consistency.

Was Project CONNSTRUCT Successful?

The documentation collected from the key participants shows that they see their project as truly successful. One State Department of Education consultant answered the above question with this statement, which is representative of other participants' views:

> *"Yes. We have been incredibly successful in helping to focus attention on the need for a higher level of mathematics and science achievement in Connecticut. When you look at the Connecticut Academic Performance Test (CAPT), Beginning Educator Support Team (BEST), gradual changes in teacher preparation programs, and more receptive public audience, we have made a difference in five years. If you look at overall test scores in mathematics and science, there has been improvement. There has been even slight improvement in the city schools."*

They make the case that, in the five years of CONNSTRUCT's existence, they have succeeded at implementing, on a statewide basis, all of the benchmarks of systemic reform of mathematics and science. That includes having a positive and verifiable impact on all of the fundamental elements and most of the drivers and cross-cutting variables identified by NSF.

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An executive officer of the Academy summed up CONNSTRUCT's success in the following factual and visionary statement:

> *"Almost everything that we have done positively has been associated with something else that we have hoped to eliminate because it was negative or counter-productive. For example, if we have achieved greater hands-on work in both mathematics and science in the classroom and laboratory, we hope that we have eliminated the passivity associated with listening to lectures and writing down words that go into filling in the blanks. If we have succeeded in getting teacher preparation programs to utilize team teaching of college professors and public school teachers jointly in classes—we have—we hope we have eliminated the lecturing by college professors who are not genuinely familiar with what goes on in schools."*
>
> *"If we have succeeded in getting parents to understand a little bit more about science and mathematics and their role in contemporary culture and to help their children to learn science and mathematics as an important part of their intellectual development—if we have done that, then we hope that we have eliminated misconceptions about science and mathematics and feelings that mathematics and science are unimportant, and that parents should play a hands-off role with respect to their children's education."*
>
> *"We would hope the schools would see mathematics and science as being central human activities, undertakings of people who need competence in these endeavors for economic reasons. That is, people need to use these things in their jobs and, also, for cultural reasons. Furthermore, people would see that mathematics and science contribute to their intellectual development and make them more humane and that everyone would have this changed view of mathematics and science. They would applaud this more positive attitude toward the subjects and would work to make the schools effective parts of the development of all children."*

The one area where the participants most readily and repeatedly acknowledge that they have produced less-than-desirable results—in view of their own criteria of success as well as those established by NSF—is improving the mathematics and science achievement of poor and minority children. An executive officer of the Academy said, "Project CONNSTRUCT has significantly improved learning, but not high achievement." Closing the achievement gap between the students that the system serves best and those historically under served "is the area where we have done the least well. We tried, but we don't have much to show." In answer to the question of just how much of a difference has been produced, a State Department of Education consultant said, "While testing scores have not yet risen

substantially, evident progress has been made, the downwards trend has been reversed, and small gains have been registered." Through their public awareness and community outreach programs, in particular, they have, according to an executive officer of the Academy, "brought to the attention of school boards, administrators, teachers, and citizens as a whole the notion that those who had been under served needed more attention."

The participants make clear that attributing to a single source, like CONNSTRUCT, the whole complex of changes produced in the areas of mathematics and science achievement in Connecticut the past five years is foolhardy. There are many different sources of influence, not the least of which is the relatively recent history, on both national and state levels, to establish standards for achievement in grades K-12 in all of the content areas. Nevertheless, they are quick to add that the Academy was established by the State Legislature in 1992 to serve as an advocate and broker for just such change, and it has done its work very effectively. A State Department of Education official said, "Science and mathematics education in Connecticut would not be in the shape they are in today without CONNSTRUCT." Hence, this project is seen by its key participants as the indispensable handmaiden of systemic reform in Connecticut.

This question came from NSF: "Has the State's system of education been *profoundly* influenced in this way?" (Italics added.) To which all of these participants mused, "Why do they use the word, *profoundly*?" Then, they matter-of-factly raised a question of their own: "How could anything short of a total overthrow—a genuine revolution—change a state's system of education in a mere five years?" A State Department of Education consultant answered both questions with the following statement: "The system has been in place for too long and is too big to be 'profoundly altered' in just five years. Additionally, the development of education in this country, like almost everything else, is best characterized as an evolution, not a revolution."

Yet, one of the most striking and, at the same time, understated accomplishment of the Academy has been its success at bringing both the Commissioner of K-12 Education, Theodore Sergi, and the Commissioner of Higher Education, Andrew De Rocco, to the table. This was done for the express purpose of mutually determining the best course of action for improving the State's K-16 system of education in order to have higher achievement in mathematics and science, especially for the State's historically under served citizens. According to an executive officer of the Academy, the Commissioner of Higher Education "sees the need for increasing the emphasis on teacher preparation in mathematics and science" and will work to improve the programs for teacher certification. The capstone of this dialogue is the agreement by the Commissioner of Education, whose agency was the principal investigator for the original grant, to transfer the management responsibility for the continuation of CONNSTRUCT's multimillion dollar enterprise to the Academy. The key participants anticipated this transfer of responsibility, but it was nonetheless difficult to

orchestrate, especially when in recent years the State Department of Education's budget has had to absorb so many cuts and, at the same time, increase its operations.

This change constitutes a profound alteration because it showed that the State's chief executive in charge of K-12 education understood the wisdom of a collaborative decision-making process—the intent and result of which placed the concern for children's education over the politics and bureaucracy that are endemic to large, corporate organizations and especially state and federal governments.[4] As a nonprofit agency and the principal subcontractor for CONNSTRUCT, the Academy has made its commitment to the reform of education felt throughout the State. What is equally important, with its lean, professional organization and excellent network of participants in business, industry, and education, the Academy is neither a political agency nor a bureaucracy. Thus, it can be expected to address the different aspects of statewide systemic reform very quickly and effectively.

Finally, from the participants' viewpoint, CONNSTRUCT has produced some tangible benefits for other states involved in statewide systemic initiatives. A State Department of Education consultant said,

> *"CONNSTRUCT has shown people that systemic reform has two critical components: (1) you have to create a coordinated, powerful infrastructure, and (2) you have to make it work. It is easier to plan and do the first critical component than the second."*

There are other characteristics of the Academy and CONNSTRUCT that help to explain its success and also to reveal the character of the individual participants as well as their corporate project. Some of these are: intelligent, broadly-based decision making; open-ended inquiry and a strong determination to get to the bottom of issues; avoidance of political machinations and bureaucracy; unwavering, long-term commitment to the organization and its ideals; even tempered, professional negotiation; sincere and sophisticated personal relations; a good sense of humor; and, above all, an idea that is emerging, however imperfectly formed, of a better statewide social organization than the status quo in order to have a truly just and effective educational program for all the State's children.

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[4]Weber, M. (1947). *The Theory of Social and Economic Organization.* Translated by A. M. Henderson and T. Parsons. New York: The Free Press.

6. Leadership of Component Three: Higher Education

In this section, there is discussion of the accomplishments of Component Three. The goal of Component Three is to establish higher education partnerships for K-12 education. The data for analysis comes from structured interviews with the current leaders of Component Three, including the Commissioner of Higher Education, from interviews with Component Three grantees on their accomplishments with respect to the operations of their mini grants and the goals and objectives of Component Three, and from analysis of survey data regarding the perceptions of Component Three operations and CONNSTRUCT itself by past and present Component Three grantees.

Was Component Three Successful?

Since its beginning, the key participants in CONNSTRUCT have said that their emphasis on restructuring the curriculum in institutions of higher education is a necessary component. This is for the explicit purpose of improving the quality of instruction in mathematics, science, and technology in Connecticut's colleges and universities for all students and especially the improvement of teacher education programs. Most of the statewide systemic initiatives have not ventured into the area of systemic reform of higher education within the context of their K-12 initiatives despite its obvious and important relationship with K-12 education, in general, and the preparation of teachers, in particular. Their hesitancy is not surprising because the focus on systemic reform of K-12 education, in and of itself, is a daunting task. Also, in and of itself, the systemic reform of a state's institutions of higher education—specifically for their substantive improvement of teaching and learning of mathematics, science, and technology—is a daunting task. Additionally, when coupled with the initiative for reform of K-12 education, the total undertaking is formidable. Nonetheless, it is necessary.

CONNSTRUCT set out to initiate change in these aspects of the State's institutions of higher education. During the fifth year, with encouragement from the Commissioner of Higher Education, the Academy made a substantial investment in Component Three operations to provide assurance that the best projects had the necessary support for success with coteaching and restructuring of courses and degree programs. Thus, it appointed Tim Craine, from CCSU, as Component Leader with support from Nancy Wogman, from the Academy, and David Pettigrew, from SCSU. Both Tim Craine and David Pettigrew had established excellent reputations, statewide and nationally, for curriculum and program development in their respective institutions. Nancy Wogman's strengths were in program management. A highpoint in the fifth year was a spring 1996 conference on standards-based mathematics and

science reform, provocatively titled "Higher Education's Choice: Lead, Follow, or Get Out of the Way." All participants in K-12 and higher education institutions received invitations. Workshops throughout the day exhibited coteaching partnerships between K-12 teachers and college professors.

The data show that Component Three has accomplished all of its objectives, particularly at the general level of analysis. During the five years of CONNSTRUCT, Component Three's principal activity was the funding of mini grants that were awarded annually on a competitive basis to any of the State's colleges or universities where there were teacher education programs operating. All relevant institutions of higher education participated to some extent. At several of these institutions, innovative and daring faculty succeeded in their endeavors to change their departments' curriculum and instruction for some courses and, in at least three institutions, to lay the necessary groundwork for the restructuring of whole degree programs in mathematics, science, and teacher education. The most successful projects and professional development programs were run by Tim Craine and his cohorts at CCSU, Babu George at Sacred Heart University, Sister Claire Markham and colleagues at St. Joseph College, and David Pettigrew and colleagues at SCSU.

However, the Component Three leadership and some of the grantees were quick to add that these successes came only after a sustained, long term, broadly-based, and sincere effort at systemic change of their college or university departments. The component leader said, "The process of change at universities is slow." This response was meant to be an understatement. One university professor and department chairperson said that unwavering support for systemic change at the institution from the dean and department head is absolutely crucial not only to a project's success, but also to the professor's tenure. To put things in proper perspective, while acknowledging that some faculty succeeded at initiating the change process in their institutions, the Component Three leader said, "there has not been a complete transformation of a university." In truth, no one had unrealistic expectations. Rather, in several instances, namely at CCSU, St. Joseph College, and SCSU, the dialogues and coteaching exchanges led to some important changes in both the participating institutions of higher education and the K-12 schools.

For example, the four projects funded by Project CONNSTRUCT this year at SCSU constituted a broadly based, cohesive approach to restructuring in an institution of higher education. Professors from departments of mathematics, science, and education were actively involved in the collaborative decision-making process and operations. Elementary school teachers were vital partners in coteaching the content and methods classes at the university and provided a grass-roots source of influence on the process of institutionalizing these long overdue changes at the university. Preservice and entry level teachers are direct beneficiaries of the revised teacher certification program. The elementary school children are learning mathematics and science in ways that not only make it understandable to them, but also fun.

Data show similar results at CCSU and St. Joseph College.

In some instances, the mini grants that were meant to support dialogues, coteaching, restructuring of teacher education, or use of technology for the purpose of initiating systemic change merely produced some "hopeful signs." In other instances, the project missed the whole point of systemic reform. To illustrate, one project at one university had a limited focus and, yet, met with limited success. Its contributions to systemic reform of higher education were restricted to the working out of technical details associated with the live broadcast of a television show. One would think that knowledge of such problems already exists among people who regularly engage in broadcast television. For example, Talcott Mountain Science Center, located in the central part of the State, has been producing live, interactive broadcasts for some time. And there is the Jason Project, which is a large-scale, successfully marketed program very much like the one supported by the project in question. However, the professor had not sought assistance from the science center or any other broadcasting agency. Systemic reform is about collaboration. Thus, in order to make the best use of human and physical and technological resources (especially when the project is not meeting with success), it would have been natural for this professor to collaborate with other universities that do research and with Connecticut-based industries that have their own research laboratories. Unfortunately, there was no thinking or plans for development in this direction.

The gross institutional inertia, which key participants described as the corporate interests of faculty and the institution of higher education, caused some initiatives to fall short of their own and Component Three's immediate expectations and fail to make the needed change in the system.

A common mistake was the belief held by ordinary college faculty that what they do is above (in a hierarchy of occupational status, knowledge, and methodology) and not mutually dependent upon the collaboration, knowledge base, curriculum, and instructional methods of their colleagues and their K-12 counterparts.[5] This false and self-serving belief contributed to a number of easily recognized negative results in some Component Three projects. To explain further, some college faculty (including teacher education faculty) proposed projects repeatedly that, as things turned out, followed the "from-the-university-to-the-school" paradigm. There was not even the spirit of collaboration, much less the practice. Data from the evaluation of CONNSTRUCT's Component Three grantees showed that these college

[5]Those who are familiar with universities know that this same negative workplace mentality exists both within and across university departments and across different colleges or universities, such that content specialists in mathematics and science, for example, might never speak to each other for various reasons and members in each of these areas might hold in disrepute their colleagues in departments of education. A similar negative workplace mentality might exist among faculty in the department of education and be directed toward different members of their own unit as well as faculty in these other content specialties.

faculty—and quite likely a substantial majority of their colleagues—are stuck in the mentality of the disinterested expert, who believes that he or she knows all there is to know and will tell others, namely K-12 teachers, what they need to know. For some faculty this negative workplace mentality may help them to legitimize the professor's most commonly utilized teaching method—the lecture. For some other faculty, to proceed with business-as-usual in the college or university may be a tacit refusal to buck the system or, alternatively, an explicit show of their actual preference for maintaining the status quo. After all, the grant provided a substantial sum of money for a pet project, and its award is very likely linked to the faculty member's annual merit pay and eventual promotion or tenure.

On a practical, evidential level, wherever college faculty operated with this ivory tower paradigm, there was a very low level of participation from the K-12 teachers and administrators, if there was any response at all. Consequently, the impact on children in the local K-12 schools was minimal. With regard to the vision of much needed change for the State's educational systems, the widespread subscription on the part of college faculty to this belief in the superiority of their status and knowledge, along with their reluctance or refusal to collaborate with colleagues, postpones the success of systemic reform. As one memberof the Academy's Executive Committee stated, the systemic reform of the State's institutions of higher education may very well depend on "waging guerilla warfare against this intransigence." By contrast, where college faculty expressed a genuine interest in working as true and equal partners in a collaborative effort to teach mathematics and science to college students, including preservice teachers, both institutions and their representatives benefitted handsomely.

Some of the observers and key participants in CONNSTRUCT relate that there are signs in Connecticut pointing to an impending upheaval in its institutions of higher education. This is a noteworthy speculation. Due significantly to CONNSTRUCT's operations, children throughout the State are engaged in authentic learning activities, where they are personally involved in problem solving, employ real world applications, and regularly use advanced technology, such as graphing calculators and computers. Most importantly, these children and their parents are increasingly empowered with a sense of self that sees learning in school as personally meaningful and valued; it is an active exchange and contingent upon personal initiative. Their best teachers are partners in the exploration and discovery of knowledge. One day soon these children, their parents, and teachers will challenge the State's system of higher education and remake it into the institution that is appropriate for modern society.

What Component Three has shown is that innovative faculty and administrators have succeeded in restructuring their degree programs, curriculum, and instruction in those institutions of higher education where there is a sincere, well-supported, and broadly-based interest in systemic change. The next step, described by the Component Three leader as "the greatest obstacle," is to change the reward system for faculty. Emphasis on effective

teaching, broadly-based collaboration with colleagues both within and outside of the institution, curriculum development and restructuring, and incorporating experiential learning should be officially recognized as meritorious, alongside that same professor's record of research and publication.

Nonetheless, there will be both formal and informal subdivisions in every organization. Thus, depending on the nature of their scholarship as well as their individual preferences, professors may very well see themselves as members of one general occupational category, perhaps defined as academic scholar, or another, perhaps defined as researcher and practitioner. Even so, there is no need for the two categories of work to be dichotomized as mutually exclusive territories; nor should they be in adversarial relations with one another. Indeed, some professors may be adept at both enterprises. However, they should be seen as necessary, complementary elements of a vital institution of higher education.

7. Leadership of Component Four: Instructional Technology

This section presents a discussion of operations associated with Component Four. In the original proposal, Component Four's title was "Creating an Environment for Change: Science-Rich Institutions, Business, Industry, Schools, Family, and Community." The switch to a more specific focus on instructional technology was made during the past two years. This was a result of several factors, including a separate grant that was awarded by NSF to the State's science-rich institutions for their development of collaborative programs to improve the teaching and learning of mathematics and science; an overlap with the emerging emphases in Component Five's community outreach; and the well-known, urgent need for the State to develop an infrastructure for technology-driven educational programs.

Was Component Four Successful?

How effective has Component Four been with helping the Connecticut Academy to implement its plan for systemic reform of science and mathematics? According to Richard Cole, Executive Director of the Academy, "It's been outstanding. We have created a statewide computer network at no cost, and we are producing two important educational guides for technology."

More specifically, the Academy engaged 13 computer systems administrators from throughout Connecticut to establish the framework for a virtual statewide education network. Each of its HomePages is now connected to the Connecticut HomePage, which is administered by the Connecticut Library and the University of Connecticut. The result is a statewide mathematics, science, and technology computer network with no cost to any of the users.

Also, the Department of Higher Education has engaged consultants to provide a feasibility study for a transparent higher education network that could be linked with the K-12 system and an audit program for progress towards a degree, wherever the credit is earned. The Connecticut Educators' Computer Association (CECA) is now working with the Academy to research, write, and disseminate two computer technology products statewide. Each will be distributed in September 1996. They are (1) A Blue Print for Embedding Instructional Technology and (2) Recommendations on the Long-Term Implementation and Funding of Instructional Technology in Connecticut Communities.

Furthermore, the Connecticut Academy has offered to work with the Joint Committee on Educational Technology (JCET) by providing funding to hire a person to assemble all of their work to date and to make a mid-term report to the State Legislature. JCET is reviewing the offer. Statewide Professional Development Program over the Community College

Instructional Television (CCIT) will resume programming during the next school year. Talcott Mountain Science Center system has been melded into the Virtual Network so the 450 subscribers are now connected throughout Connecticut.

The move away from the widespread, original objective for Component Four to its current, more specific focus was a wise move. Also, the Academy's use of "goals" in its latest proposal to NSF in place of "components" is wise, because the refinement of goals over time is a more reasonable way to meet the exigencies that are bound to occur than the abandonment or total transformation of a component. The Academy sensed that it could not be truly effective in making use of—much less creating a climate for—instructional technology unless all of the key organizations and individuals were in agreement that the infrastructure for cooperative use of advanced technology had to be established in the State. The data here and elsewhere in this report show that Component Four has succeeded in creating an environment for change (its original charge); it has established a foundation that should support the continued development of the State's instructional technology for improving the teaching and learning of mathematics, science and technology for teachers, students, their parents, and all of Connecticut's citizens.

Finally, based upon the analysis of data, the Academy should retain and develop further its program for technical assistance (an objective in the original proposal for Component Four), which included linkages between teachers and students in priority school districts and corporate work settings, science-rich institutions, and model schools. In addition, the Academy should create a system for making the most efficient and effective use of the Academy Fellows. This statewide system for delivering technical assistance should cover a wide range of educational needs dealing with the development and use of curriculum and instruction in mathematics and science, including instructional technology. It should be an essential element of the new professional development program.

8. Leadership of Component Five: Public Awareness and Community Outreach

In this section, there is a discussion of Component Five. Its principal concern is to create public awareness of the State's need for improving the teaching and learning of mathematics, science, and technology. It must also provide community outreach services to assure that parents and residents of neighborhoods, towns, and cities all across the State are not only well-informed, but also have some tools to help facilitate the systemic change of education. Data included responses from the Component Leader to structured interview questions, documentation published by the Academy for Component Five, study of its products, and observations of main events.

Was Component Five Successful?

All of the key participants and many observers elsewhere in Connecticut and other states expressed their high regard for the work and the products that flowed from Component Five during the five years of CONNSTRUCT's existence.

According to Mary Keeney, Director of Public Engagement and Component Five Leader,

> *"The purpose of Component Five is to help schools build positive relations with their parents and communities. It also watches for successful programs in the different districts and helps to foster their growth. It disseminates those findings through the Academy's information network. The Academy makes phone contact every day with school districts and communities to help them do these things better."*

At the Academy the phone rings constantly with people calling to ask questions that stem either directly or indirectly from Component Five's operations and products. Some of its products, and most especially the program entitled "Learning Doesn't Take a Vacation," have been very successful with parents, neighborhood organizations, and business and industry. Component Five's positive reputation in the informal education market has the attention of almost all of the State's media publishers and producers. They are pleased to be associated with the Academy as partners in the statewide effort to improve the teaching and learning of mathematics and science. Also, the success of Component Five's operations in public awareness and community outreach has helped the Academy to retain its original private and public sector funders and to win new ones among the State's business and industry leaders.

Mary Keeney readily admits to learning some lessons the hard way—through practical experience. In particular, she discovered that she had to decide at what point to pull away

from an initiative she had started in a community. She had to avoid over-committing herself and her assistants and, at the same time, to allow the local participants the chance to take ownership and create their own project. Otherwise every project could escalate into a never ending duty. However, since the work of Component Five was an entirely new initiative with no precedent to follow, there was no way for the leadership to know in advance what works. To accomplish Component Five's original objective, which was to campaign for public understanding, CONNSTRUCT did not hire a public relations firm, as was done by other statewide systemic initiatives.

In clarification of this distinction, an executive officer of the Academy said,

> *"Component Five did not just 'raise awareness.' We decided that it would be wasteful to spend $30,000 - $50,000 with a public relations firm on a campaign to create public service announcements. We learned that television doesn't work. That's a top-down method. Typically, these announcements are broadcasted on television between 11:30 p.m. and 3:00 a.m. What does work is getting to the Parent-Teacher Associations. Component five would create a referendum to support higher standards for education in Connecticut."*

Ms. Keeney expressed the Academy's sensitivity and concern for meeting the educational needs of urban communities and the members of minority groups and the poor through Component Five. She said the following,

> *"We need to do more work with parents from disadvantaged circumstances—our poorest families. You don't just send them something in the newspaper. It is labor-intensive work and has to be more global. You need to win their trust and answer some other questions, like how to get their children to school on time. This is the value of our current work in Bridgeport. We noticed that they are getting their parents involved. The principal and teachers at one school in Bridgeport are helping us to figure out how to do community outreach. The Bridgeport model is a good prototype for other communities to follow."*

The analysis of data shows that the high quality products and the positive public response argue convincingly that the operations of Component Five were handled in a highly effective, professional manner.

9. Closing Remarks

In this final section, before the conclusion to the summative evaluation of Project CONNSTRUCT, there is a brief explanation on the history of the evaluation and the early history of the Academy. Curriculum Research and Evaluation began the process of evaluation at the request of the Academy in autumn of 1992, the first official year of the Academy's existence. In truth, this was somewhat late in its history. The founding members had actually taken their first steps toward development of some kind of program devoted to improving mathematics and science education in Connecticut in the two or three years prior to the request for proposals that NSF issued.[6]

Hence, to appreciate the scope and intensity of this project's development before its official, five year history, it should be known that these men and women were at the cutting edge of educational reform on state and national levels. They had already conceived a general scheme for Connecticut before NSF's announcement. Although they worked feverishly when the time came for writing the proposal for NSF, they nonetheless did not hastily throw together ideas, components, and people. They knew who in this state was doing what in business, industry, government, and education and how these people and corporate organizations could be instrumental for assuring CONNSTRUCT's success. At the outset, the broadly-based, collaborative decision making process for all stakeholders was there to be fully implemented.

CRE's data collection began with an interest in the history of the people who made the Connecticut Academy for Education in Mathematics, Science, and Technology. From there, plans evolved every year for the annual formative evaluation of CONNSTRUCT. CRE's concern, as well as its responsibility, was to develop a strategy for data collection that would have a low impact on the operations of the Academy; focus especially on components one, three, four, and five; and yield a narrative report of CONNSTRUCT's development and impact. The focus of the formative evaluations, especially in years three through five, was influenced to some extent by the interests of NSF. This summative report is the final piece of CRE's five-year effort to take stock of Connecticut's Statewide Systemic Initiative. In the future, there should be more emphasis on the history of these people and the Connecticut Academy. Also, CRE would prefer to study the impact on school districts, which was the focus of Component Two and was evaluated by the State Department of Education.

Seeding the Fundamental Elements of Reform
Equity, Quality, Scaling-up, Coordination and Organization

CONNSTRUCT has not solved the most intransigent of problems—high achievement for

[6]Other educational reform initiatives, such as PIMMS, had long ago established a conceptual framework for the improvement of mathematics and science education and had a network of key participants.

the truly disadvantaged children in the State and complete transformation of the institutions of elementary, secondary, and post secondary education, including their political and corporate entities in state offices and union halls. In the words of many participants, "five years is *nowhere* near enough time to change something that is so big and powerful and has been in this state for so long." However, CONNSTRUCT has shown what it takes in terms of ideas, operations, and collective energy to establish fully the benchmarks for success with statewide systemic reform of education and to accomplish, in this short time frame, all but the most distressing of national goals—high academic achievement among poor and minority children.

CONNSTRUCT is both broadly-based and cooperative. Data from interviews, observations, surveys, and documents show that all levels of the educational continuum in Connecticut are involved in this systemic reform initiative. CONNSTRUCT is not operating in one part of the state and unknown or absent from another part. Its operations cut across all economic, social, and geographical areas. Its constituencies include participants and stakeholders from some of the largest and most influential corporations. State government, including the legislature and the Governor's office, the State Department of Education, and the State Department of Higher Education are key players.

No one thinks of the Connecticut Academy or CONNSTRUCT as a one-shot-deal. The contrary is true. Indeed, at the mid-point in the evaluation of funded projects it is all too common to observe in the participants' attitude and behavior a gradual—at first and then increasing—reluctance to do things to complete the full list of objectives of the project. Everyone associated with the project knows that the money will run out soon. That is not so with CONNSTRUCT. Of course, the Academy's executive officers and staff are aware that the federal support may well end with this fifth year—and that would have implications for their budget and operations, not the least of which would be the loss of jobs for some of these people—but one does not observe shrinking lists of work details or lowered commitments in day-to-day activity at the headquarters in Middletown. Also, the 31% return on CRE's survey, which was mailed in the spring of this school year, was an expression of the serious commitment to this project by many other important players.

In regard to the accomplishment of the goals and objectives for systemic reform of education, CONNSTRUCT is timely and effective. There are very few people in this state who are directly involved with education—and certainly no one who is seriously concerned with systemic reform of education—who do not know about CONNSTRUCT and the Connecticut Academy for Education in Mathematics, Science, and Technology. There are many people in other states who know about the Academy and have benefitted from its example and products.

There are two areas where CONNSTRUCT has shortcomings, and both are understood best

as "egregious historical accretion." First, although the project has had from its inception a strong commitment to improving the achievement of all children, with particular emphasis on girls and disadvantaged children—members of minority races and ethnic groups, the poor, and the handicapped—test data show that there is, at best, only incremental improvement in the State's urban school districts, where most of the poor and minority children reside. To their credit, CONNSTRUCT's executive officers, as well as the Commissioner of Education and his curriculum consultants at the State Department of Education, readily acknowledge this shortcoming and vow to redouble their efforts and operations soon in order to make a significant difference. In the first five years, CONNSTRUCT has at least established the benchmarks for improving the achievement of disadvantaged children in mathematics and science. These are the platforms of policies and practices which include, among other things, restructuring the curriculum, implementing problem-based assessment, and encouraging professional development, all of which is aligned with the standards in science and mathematics. The fact is: five years is just not enough time to change a system of education that has been set in New England for over three hundred years.[7]

Second, this systemic reform initiative has produced encouraging, but spotty, results in the State's institutions of higher education. There are models of success, such as at CCSU, St. Joseph College, SCSU, and, recently, University of New Haven, but there are also pockets of resistance, such as at the University of Connecticut. In the past five years in K-12 school districts, there have been collaborative, broadly-based, dynamic changes in the professional development of mathematics and science teachers, the restructuring of these curricula, and even reorganizing the work day, due largely to CONNSTRUCT. Some of the K-12 teachers have made significant contributions to the restructuring of university courses and programs through dialogues and coteaching assignments. There has yet to be a substantive, statewide, collaborative initiative located in the institutions of higher education that is devoted to the restructuring of the State's public universities, with a special emphasis on mathematics, science, technology, and teacher education. Nor is there a vision encompassing the fullness of human learning processes and knowledge applied to the whole spectrum of formal education from K-16 for all students.

University progress nationally, as well as in Connecticut, is both aided and incredibly stifled by its nearly one thousand year history.[8] Too many of the sitting presidents, deans, department heads, and professors perform their duties according to ancient customs and

[7] *The Old Deluder Satan Law of Massachusetts* was enacted in 1647.

[8] The first universities (proper) were established at Paris, Bologna, Cambridge, and Oxford in the eleventh and twelfth centuries.

express an arrogant disregard for other persons, most especially their students. Impersonal lectures, unclear or informal policies, and fragmented, isolated faculties, to name but a few of higher education's ills, are legitimated today as much by academe's tenure and unions as by its apathy and custom. The time for change is coming, announced daily by the clarion calls from technology and the truly vital institutions of higher education. During the next five years, the Academy intends to have a substantive, positive impact on the State's higher education establishment.

CONNSTRUCT's successful brokering to make the Academy the principal fiscal agent for systemic reform instead of the State Department of Education will enable it to develop policies and operations autonomously while, at the same time, work as a genuinely equal partner with all of the stakeholders, especially the State Department of Education and the State Department of Higher Education. There is much wisdom in creating this new identity and organization for the Academy. Now, its decision making process is not tied to any particular governmental or corporate entity, where bureaucracy, politics, and the career aspirations of some individuals may have more to do with decisions than the educational needs of the State's truly disadvantaged children. Fortunately, these machinations have not been commonplace in the Academy's history. The Academy truly exists to serve the State of Connecticut as the advocate and broker for systemic change of education. The positive effects of the Academy's new generational plan for improving the teaching and learning of mathematics and science should be felt soon, and not just in the K-12 classrooms, but K-16 classrooms, the halls of state departments, the State Legislature, the board rooms, offices, and shop floors of the State's business and industry. CONNSTRUCT has made a grand opening for systemic reform of education. There is yet much work to be done.

The best kept secret is that the people who are directly responsible for this project's success are the most thoughtful, patient, and persistent stakeholders of all. They are the citizens of Connecticut. No one is turned away who is seriously interested and will work collaboratively on their mission. They work smart and very hard on the systemic reform of education for all of Connecticut's children.

Biographical Sketches

Curriculum Research and Evaluation is a firm that is devoted to research and development of programs in the field of education. CRE's specialities are: (1) to provide services in order to evaluate the quality of education programs for private business and industrial companies, public and private funding agencies, and schools; and (2) to develop and guide the implementation of curriculum and instruction.

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