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AUTHOR Cooper, Bruce S.; Hummel-Rossi, Barbara
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ABSTRACT

Because of a serious teacher shortage nationwide, it has become common to find many teachers teaching "out of license"--teaching courses in which they have had few or no college courses. In an attempt to address this problem, New York City has embarked on an innovative program to relicense teachers in mathematics and science to fill the increasing shortages of staff in these areas. The concept has been to take experienced teachers and to give them the tools to change fields, to apply their skills and ideas to math and science, without risking the loss of a job or great financial expense. This paper describes the operations of the model, which has required the close cooperation of 11 universities and colleges, the New York City Board of Education, and the City of New York. The paper also examines (1) racial, ethnic, gender, and success rate statistics of participants in the program and (2) the success of the model itself and its applicability to the solution of the teacher shortage. Advantages of the program include (1) cooperation among teachers, (2) enhancement of choice, (3) public reimbursement, (4) decentralization, and (5) adult development. Five tables are included. (IW)

RE-LICENSING TEACHERS INTO MATH AND SCIENCE:

A Creative, Short-Term Solution to the Teacher Shortage

Bruce S. Cooper, PhD
Fordham University & the
University of London

Barbara Hummel-Rossi, PhD
New York University

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RE-LICENSING TEACHERS INTO MATH AND SCIENCE:

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Introduction

The career life of a schoolteacher is no longer simple. Today, our Ms Dove or Mr. Chips confronts major concerns about such problems as "career ladders" (shoots or ladders), "career development," "burnout," "merit pay," or is it "de-merit non-pay?", and "master teachers" and "mastery learning." All this, on top of the "normal" day's work, the pressures from the profession, the union, the parents, the administration. Yet, for all these rising expectations and increased opportunities--offered by career ladders, development, improved pay for improved services--little attention is being paid to the direct skills training of teachers: to the acquiring of new and useful knowledge and information.

Take a real situation, in New York City. The Board of Education cannot find teachers in areas like mathematics (junior and senior high levels) and sciences (biology, physics, chemistry, earth science, general science). So, to fill the slots, teachers are assigned to instruct mathematics or science "out of license," placing licensed teachers in history into algebra courses, physical education instructors into physics sections. Not ideal, turning classes in vital subjects over to people with no college courses in those disciplines: no background in

the fields they are supposed to teach. But, given the shortages and the pending retirement of thousands of veteran teachers in these subjects in the next two decades, the holes in the teaching force will widen and the need to do more than build career ladders will become crucial.

The need, then, is for some direct way of delivering training to teachers, who already have experience and commitment, but who lack the background in such basic subjects as biology, astronomy, trigonometry, probability, and calculus--all standard courses in the nation's schools. Obviously, it would be useful to recruit thousands of new teachers in these areas; but in the last twenty years, fewer and fewer college graduates with these credentials are opting to teach (low salaries and little glamour). Re-licensing and re-certifying is an exciting short-run possibility. It applies the bandage directly to the wound; it brings the teachers in the classroom up to speed; and it is economical, since the teachers who are already there, involved, and tested, are provided the tools they need (rather than risking large sums of money on candidates for teaching who, once trained, find a more attractive and lucrative job in industry).

Extent of the Problem

Before discussing a bold attempt in New York City to relicense mathematics and science teachers, it is useful to examine the problem itself: the critical shortage of teachers particularly in these vital, technical subjects. These shortages are related to a number of changes in the demography of education and the complex process of career choice among young adults entering the job market. Only 2 percent of the nation's under-

graduates expressed any interest at all in teaching (see THE CONDITION OF EDUCATION, 1983, National Center for Education Statistics). This lack of interest is ominous when held up against the dire need for teachers in mathematics and science now and in the future.

In California, for example, half the high school seniors were "taught by teachers with a minor or less in their subject. . . ." (JOURNAL OF THE CALIFORNIA MATHEMATICS COUNCIL, April 1983). Various states recorded rising needs for such instructors: Florida needed 600 mathematics teachers in 1985; Nebraska 446 new ones; New York City requires about 250 mathematics and 190 science teachers now. By 1990, the numbers should triple, as older teachers retire and leave the system. In a recent survey, it was found that one teacher in four in mathematics and one in three in science were teaching out of their license area. The law allows this filling in if the teachers' main work is in-license. That is, a teacher certified in, say, history, may teach two out of five periods per day, say, in biology, if the district cannot find such a teacher and declares an emergency situation.

Overall, then, the nation has a teacher shortage--and a greater one in mathematics and science. Bowen in TIME magazine predicted that by 1990, we would need upwards of a million new teachers for the nation's elementary and secondary schools, based on estimates by the National Education Association in 1985. In math-science, the data are more disturbing. In the Soviet Union, for example, Grayson of the National Institute of Education reported that there were 123,000 physics teachers, while the U.S.A. had only 10,000. Whatever the situation, a number of conditions have converged to exacerbate the problem:

1. Cut-Off of New Teachers. A number of factors have reduced the flow of new talent into teaching. The reduced size of the pupil population, the financial constraints, and the loss of interest among new candidates, have all combined to diminish the new staff entering teaching. These reductions have been most severe in the difficult-to-fill areas of mathematics and science where college graduates can easily find other employment in computer technology, engineering, and business.

2. Retirement and Relocations. Compounding the shortage of new teachers is the loss of older ones. With the mean age of the teaching force reaching the forties, and with teachers finding interesting employment in other fields, the ranks are being cut by teachers leaving education. By the year 2000, over half the teaching force of today will be gone, requiring the enlistment of nearly 2 million teachers--and, again, math and science will be very hard hit.

3. Poor Opportunities, Poor Pay. Teaching still has a reputation as being a weak profession, one with low status, poor pay, and little long-term opportunity for promotion. It is a "flat" profession, with easy entrance and few benchmarks during a career. While doctors move from intern to resident to specialist to senior physicians; professors from lecturer to assistant to associate to full; and lawyers from junior, to associate to vice president to partner, teachers manage to be "just" teachers throughout their lives: few markers of status or attainment. And pay is relatively small and incremental. Nothing to point to as the year I made it to _____. Just teacher, teacher, teacher!

Recertification: An Innovation

New York City tried a direct approach. It sought funds from the City, particularly the office of the Controller, Harris J. Golden, to sponsor courses in mathematics and science at universities and colleges in the metropolitan area. Courses were to be taught by professors of the sciences (physics, biology, chemistry, and earth science) and mathematics to NYC public school teachers after hours, on the college campuses, in classes exclusively reserved for these Board teachers (it would be difficult to thrust middle-aged teachers into classes with ambitious pre-medical students in their late teens).

The Board of Education paid a flat rate per student credit to the colleges and a subvention for course books and materials. Thus, NYC school teachers did not have to lay out money in advance and then wait months for re-payment. Colleges were encouraged to provide a range of courses from basic to advanced, leading to the required number of credits for licensing:

1.	Junior High Mathematics:	18 credits
2.	Senior High Mathematics:	24 credits
3.	Junior High General Science:	36 credits
4.	High School Biology, Physics, Chemistry, Earth Science:	36 credits

It is possible to seek both junior and senior high licenses with the same credits; thus a candidate might use the first 18 credits toward a junior high mathematics license; then by taking 6 credits of calculus, add them to the 18 and accumulate the required 24 credits to apply for the licensing examination.

Once teachers have passed the science or mathematics examination,

they are ready for assignment to a school as a regular teacher; after two years of successful teaching in their new field of mathematics or science, they are eligible for tenure (their second) and a regular license.

The Institutions

The model is a unique one. It involves city funds, school board teachers and direction (out of the Division of Curriculum and Instruction), and universities and colleges to do the teaching. All five boroughs of the City are represented; Catholic, independent, and public colleges/universities, city and suburbs. Table 1 shows the participating universities, their location and type.

Table 1

Mathematics/Science Re-Licensing Colleges

1. Bronx Community College	Bronx	2-Year	Public	Math & Science
2. Brooklyn College	Brooklyn	4-Year	Public	Math & Science
3. City College	Manhattan	4-Year	Public	Math & Science
4. College of Staten Island	Staten Island	4-Year	Public	Math
5. CUNY-LaGuardia Community College	Manhattan	2-Year	Public	Math
6. Hofstra Univer.	Nassau County, LI	4-Year	Private	Math
7. Lehman College	Bronx	4-Year	Public	Math
8. Kingsborough Community Coll.	Brooklyn	2-Year	Public	Science
9. Manhattan College/ Mt. St. Vincente	Bronx	4-Year	Catholic	Science
10. Queensborough Community College	Queens	4-Year	Public	Math & Science
11 St. John's University	Queens	4-Year	Catholic	Math & Science

OTAL:

Colleges/Universities=11, Mathematics=8, Science=6

Public=8, Private-1, Catholic=2

This distribution of programs and universities means that NYC public school teachers can easily reach a re-licensing program near their home/work. Classes are offered in a range of subjects, taught at the introductory and intermediate levels (undergraduate). In science, for example, courses include:

Principles of Science
Genetics
Biology
Seminar in Physics
Ecology
Physical Geology
Physics
Meteorology
Astronomy
Topics in Plant Biology
Fundamentals of Chemistry
Topics in Science
Biological Conservation

In mathematics, courses include such topics as:

Fundamentals of Mathematics
College Algebra
Number Systems
Probability and Statistics
History of Mathematics
Introduction to Mathematics Reasoning with Computer Applications
Basic Concepts in Geometry
Calculus I and Analytic Geometry
Calculus II

Besides these courses, offered at different times at different colleges, the Mathematics/Science Re-Licensing Program also includes some career/course counselling, tutoring for students having difficulties, and preparation for the examinations given by the NYC Board of Examiners.

The program is in its third year, and has shown the possibilities of serious cooperation among institutions in the NYC area to combat the shortages of crucial teachers. Much can be learned about the training of teachers, and by implication, about the career develop-

ment of teachers in important fields such as mathematics and the sciences.

The Cooperative University-School District Model

During the 1985 school year, the Re-Licensing program in NYC was evaluated by the Board of Education (See Hummel-Rossi, 1986). As shown in Table 2, one hundred courses were provided to teachers in the city schools (62 in Mathematics; 38 in science). Using the participants in 1985 (and those who entered between 1983 and 1985), we shall examine the issues of who the participants are, their racial, ethnic, and gender statistics, and the success rate in the program. Then we shall examine the model itself, to discuss its applicability to the solution of the teacher shortage.

Table 2

Number of Mathematics and Science Courses Offered Fall 1984, Spring 1985, and Summer 1985

	Fall-Spring 84/85		Summer 85	
School	Math	Science	Math	Science
Bronx Comm	1		1	1
Brooklyn Col	6	7	2	3
City Col	7	5	2	2
CUNY	2	2	2	
Fordham U	2		2	
Hofstra U	4	1	2	1
Kingsborough Comm		3		2
Laguardia Comm	2			
Lehman Col	4		2	
Manhattan/Mt. St. V		4		1
Queensborough Comm	7	6	2	
St. John's U	4		2	
Col of Staten Is	6			
TOTALS	45	28	17	10

Total Mathematics courses offered = 62

Total Science courses offered = 38

Total courses offered 1984-85 = 100

The Participants

Crucial to education in science and mathematics is for minorities and women to overcome their fear of these subjects. In the past, girls and boys had few models, since women physics teachers were a rare commodity indeed. One of the goals of the Mathematics/ Science Re-Licensing Program in NYC was to enlist as many black, hispanic, and women teachers to seek re-certification as possible. Perhaps, the "second time around," these teachers might take the risk and obtain a license as an instructor in these subjects.

Data from 1985 show that of the 626 teachers who participated in the program in 1985 (another 459 were involved in the previous years), some 61 percent were women and 45 percent were minority. These data are considerably higher than the figures for the Public Schools of NYC, where only 17 percent of the teachers in all high school subjects are minority and 28 percent minority in junior high teaching. And women make up 52 percent of the Board's junior high and 46 percent of high school teachers, while the Re-Licensing program had 62 percent women. It is not known exactly how many or what percentage of science and math teachers in NYC are women, though it would be considerably lower than the totals for all subjects taught by women and minorities. Table 3, showing data from the Hummel-Rossi evaluation, shows the totals for blacks participating in the math and science parts of the program (35% in math were black; 36% in science), while the Board has only 11% black as teachers in high schools, 20% in junior high, and 17% in elementary. Hispanics made up about 7% of the program, while this groups comprised 4.5% of high school teachers, 7% of junior high, and 9% of elementary.

Table 3

Ethnic Composition of Mathematics and Science Program Teachers Compared to All Board High School Teachers

	Ethnic Group			
Teachers	Black	Hispanic	White	Asian/Indian
Recertification Program Math	35.4%	7.2%	54.6%	2.8%
Recertification Program Science	33.6	7.1	57.1	2.2
All Board High School	11.1	4.5	82.9	1.5
All Board Academic High School	10.2	4.5	83.9	1.4
All Board Jr/Inter High School	20.3	7.0	71.9	.9
All Board Elemen School	17.0	9.4	72.7	.9

Note. All figures in the above table are percents. The recertification program figures are from fall, 1985 and are based on a total of 458 teachers in mathematics courses and 226 teachers in science courses. The All Board figures were provided by the Board's Student Information Services/ODPC and are October, 1984 "BEDS" data; they are calculated from a total of 13,873 Board high school teachers, 11,349 Board academic high school teachers, 12,500 junior high/intermediate school teachers, and 23,778 elementary school teachers.

Problems

Getting trained to teach mathematics and science, particularly at mid-career as a full-time teacher, is not without its difficulties. Many of these participants were middle aged (average age was 42), had years of experience teaching in areas other than math or science, and had not studied these subjects in some cases since their own high school days, 25 years ago or more. While most of the teachers

had masters degrees in their own first subject (elementary education, social studies, English-Language Arts, or education), few had taken pure mathematics or science (with required laboratories) since undergraduate school, if ever. Hence, as one could predict, the adjustment to this kind of study was difficult for many teachers who participated in the program.

This academic difficulty was compounded by the schedules that many of these teachers kept during the school year: teaching from 8:20 am to 3:00 pm, rush to the university by subway or car, and attend classes from 4:00 pm to 6:00 pm, from 6:30 to 8:30 pm, and then go home, two or three nights per week. The hours were even more lengthy for science classes, since labs were required. Then, there was homework, tests, projects, writing. Thus, it was no surprise that a number of participants found the classes difficult, the time forbidding, and were unable to finish the first class (or failed it). A third dropped out or failed to complete their first math course; half of those entering the science component of the program did not finish the first course successfully, thouhgh the numbers and percentages improved as the terms and years wore on. Table 4 shows the breakdown of mathematics and science applicants by non-completion and completion of courses (Hummel-Rossi, 1986).

These students voluntarily withdrew or failed the class; since the program had no formal admissions criteria--other than the interest in re-tooling and in some cases an experience teaching math or science "out of license," the drop-out/failure rate was in part the result of the "open enrollment" policy of the program. The goal was to get as many teachers into a program who needed and wanted a try at re-licensing. It was not elite or exclusive; so

like many open programs, the first few courses act as a screen.

Table 4

Applicants with Passing and Non Passing Grades by Date of First Enrollment

	Math		Science		Total	
Applicants	#	%	#	%	#	%
No passing grade, F grade, withdraw	212	34	147	51	359	39
At least one passing grade & first enrollment:						
Fall 83-Sp 84	174	28	24	08	198	22
Summer 84	52	08	37	13	89	10
Fall 84-Sp 85	177	28	81	28	258	28
Date Unknown	7	01	1	00	8	01
Totals	622	99	290	100	912	100

Note. One college's spring 1985 data arrived too late for inclusion. Data obtained through spring 1985.

Successes

The purpose of the program was to license (re-license) teachers in mathematics and science, to fill the increasing shortages of staff in these areas. The concept was to take experienced teachers and to give them the tools to change fields, to apply their skills and ideas to math and science, without risking the loss of a job or great financial expense.

The measure, then, of the success of the Mathematics and

Science Relicensing Program is the number of teachers who completed the required course credits (18 junior high math; 24 senior high math; 36 credits science), who filed and took the licensing examination given twice yearly, and who passed the test and filed for the second license. Table 5 shows the comparison between candidates from the Program and those who were not retrained by the Board in this program. This comparison gives some basis for analyzing the outcomes of the program.

Table 5

Comparison of Program Teachers and General Population Teachers Passing Board's Mathematics Licensing Exam

School	Fall 1984 App. #	Fall 1984 Pass #	Fall 1984 Pass %	Spring 1985* App. #	Spring 1985* Pass #	Spring 1985* Pass %	Total App. #	Total Pass #	Total Pass %
Jr/Int Sch									
Gen Pop	304	36	12	135	45	33	434	81	18
*Program	36	10	28	27	12	44	63	22	35
Day Hi Sch									
Gen Pop	512	122	24	212	22	10	726	144	20
*Program	24	6	25	45	14	31	69	20	29
Total Sch									
Gen Pop	816	158	19	347	67	19	1160	225	19
*Program	60	16	27	72	26	36	132	42	32

*Spring 1985 data do not include May 1985 exam which was being scored at the time of this report preparation.
Note. App. refers to teachers applying to take the licensing exam and Pass refers to those passing the exam.

The last column indicates that only 18 percent of the general population (those not in the Program) passed the Licensing Examination in mathematics, while Project alumni/ae scored almost twice as well (35%) when taking the Junior High examination. For the high school test, row #2, 29 percent from the Program passed, while 20 percent

of the non-participants passed. When totalled up, a third of those sitting for the examination passed from the Program, while the general population saw only 19 percent completing the Board of Examiner's Test successfully in 1985.

So in 1985, Spring, alone, 88 mathematics teachers, fully licensed, were added to the work force in the NYC Public Schools, a windfall in comparison to the national situation, where, for example, the entire state of Michigan university system in 1985 license 12 math teachers (who knows how many actually elected to enter the teaching profession). With the nearly 1,000 teachers who have participated, in mathematics and science, if about a half to a third make it through to re-licensing, it will mean an additional three to five hundred certified teachers in those subjects.

The Model and the Problem:

Re-licensing experienced teachers has several immediate advantages as a form of adult, mid-career improvement and development. In the Bacharach, Conley, Shedd study of career "ladders," the authors argue persuasively that the exclusiveness and the tacit put-down of teaching are main reasons why the ladder concept is unacceptable. The very concept of a ladder, with high and low rungs, with fewer available places at the top, personifies the shortcomings of many attempts to reform the career development and opportunity for teachers.

Re-licensing has been popular and successful in NYC. Unions have been active supporters of this approach, donating space in the union newspaper to help get the word to fellow teachers about the free courses at regional universities and colleges, that

re-licensing allows teachers to develop as teachers, not to "escape" the classroom for "higher" level posts in the district. Re-licensing is not a promotion-into-administration, posing as something else. There are no quotas, per se. Any teacher who wants to improve his or her teaching skills in a new field can apply. Obviously, there are limited funds; but to date, no teacher has been turned away for lack of money to re-train. If anything, given the time and pressures on teachers, fewer than expected have taken advantage of the chance to gain a new license in a new field.

While career ladders, according to Bacharach, Conley, and Shedd, tend to foster competition for the few good spots at the top, the re-licensing program has done just the opposite. It encourages old and new math/science teachers to work together, to share their new-found experience and knowledge for the benefit of students. Judy Warren Little, in the American Educational Research Journal, states that teachers must develop over time, steadily, not through sudden leaps "up the ladder." She terms this "norms of continuous improvement" (1982), not a "quota of excellence" (see Bacharach, Conley, Shedd, 1986, p. 5), important considerations when examining staff development programs.

Re-licensing, then, does not focus on (1) promoting teachers out of teaching and (2) setting narrow quotas for people at the top. Rather, re-licensing works with the teachers as teachers, in their classrooms, arming them with new knowledge, new ideas, and a new certificate, which allows teachers to move into another subject field without losing the benefits, experience, pension payments, and colleagues of the prior teaching area. It clearly makes teachers the "decision-makers," not the envied stooges of

of a system that promotes the few at the price of the many.

Re-licensing has several other advantages as well. It shares many of the characteristics of other adult training efforts, successful ones like the G.I. Bill. It includes the following:

1. Enhancement of Choice. Teachers in NYC are now offered a choice. They can re-tool themselves, at no personal financial costs, to teach in a new area where jobs are available and opportunities for growth are common. Teachers often complain about feeling trapped, with few chances to grow. Career ladders give a few select teachers an opportunity to change their lives, at the cost to the rest. Re-licensing opens up choice to all who have an interest in new fields. It allows them to opt for staying in the classroom over leaving it.

2. Public Reimbursement. The Board of Education did not attempt to provide these services itself; rather it contracted with colleges of the City University of New York (CUNY) and other private and Catholic schools to give the courses throughout the region. Public reimbursement was preferable to setting up courses at the Board. It allowed most of the funds to go directly to the teachers, rather than trying to set up a whole program from scratch.

3. Decentralization. Another advantage of this program is its decentralized structure. Colleges and universities offer appropriate courses, using their own facilities, staff, and resources, playing to their strengths, rather than trying to

hold control at the central board. Also, decentralization gives potential participants (in this case, NYC teachers) a range of locations, courses, programs, and styles (some colleges give applied versus theoretical approaches, prerequisites or no, long courses meeting only once per week versus shorter, more intensive versions). The only central requirement is that all courses must be regular, catalogue, undergraduate offerings; the kind of presentation, where, how oft and how long, are all left up to the colleges and their clients--the NYC teachers.

4. Adult Development. This program fits nicely into the Bacharach-Conley-Shedd conception of effective career development for teachers and other professionals. It is offered widely and openly--rather than making it the exclusive property of a few "master" teachers on a career ladder. Second, it is non-competitive, available upon need. Thus, teachers do not feel superior if they are in and inferior if not. Third, the Mathematics/Science Re-Licensing Program fits into the notion of continuous growth and development for adult professionals, offering them a chance to improve their skills and move laterally from teacher of, say, history to that of mathematics or science.

Many participants, particularly women and minorities have said something like this: "When I went to college, people told me to stay away from the 'hard' subjects like math and physics. Now, that I'm older and have a profession, I've nothing to lose. And guess what? I can handle these subjects, teach them, and develop a new side of myself."

Further, teachers explain that having a license in mathematics or science gives them greater job security. While social studies

or elementary school certificates might lead to a lay-off or an unwanted transfer, the math or science license makes them rare commodities and gives them extra leverage on the job. Being a double or triple threat (say, social studies, junior high and senior high math or science) provides teachers with greater opportunity to select a school and class to their liking.

In summary, the United States faces a real crisis in the recruitment and training of teachers in science and mathematics. The statistics on shortages are understated: many schools are using unlicensed teachers in these areas--for a few periods of coverage out of license. Thus, children have a "math teacher," even though it becomes obvious that the teacher is staying only a few classes ahead of the students.

To meet the crisis, the nation must attract new talent into teaching in these disciplines. A number of long-term solutions are being suggested, such as tuition tax credits for teachers, scholarships, loans that disappear as teachers teach after college, and of course, greater pay for first-year staff (New York and New Jersey are setting entering salaries at around $20,000). These solutions have only partially worked; short-term answers are needed now.

Re-licensing is just such a solution. In New York City, nearly a thousand teachers have begun the recertification process, with hundreds already relicensed in math or science. This program has required the close cooperation of eleven universities and colleges, the NYC Board of Education, and the City of New York. Nothing is small or simple in the Big, Complex Apple. But if

it can make it there, it can make it anywhere. Other communities should consider paying the tuition and books for teachers to take courses toward a second license, particularly if these teachers are already instructing these disciplines "out of license."

Besides meeting the immediate and critical need for teachers in the short run, recertification also fits nicely into the most recent theories of career development for teachers. This approach permits professionals to develop continuously, freely, non-competitively, and non-exclusively. Teachers work together on a common problem, not on precarious ladders where one makes it and the others do not. The goal is not to beat the other person out; but to work shoulder to shoulder to overcome a national crisis. Why not reward those who have given long service to students by letting them re-train? This may be preferable to spending thousands of dollars on non-teachers on the vague promise that they might enter teaching--when they do not really want to and may decide to quit or stay on grudgingly.

The future of technological society rests with math/science education. Unless children have competent, outstanding teachers, with training in the hard sciences and mathematics, students cannot go on to higher education and good jobs. Our nation is at risk. We need ways to get real courses to real teachers, now. Re-licensing may be just such a way, giving courses to teachers who are willing and able to get their second teaching license--and to teach science and mathematics to the future engineers, computer technicians, mathematicians, doctors, biologists, rocket scientists. It's now or never!

References

Bacharach, Samuel B., Conley, Sharon, and Shedd, Joseph B., BEYOND CAREER LADDERS: STRUCTURING TEACHER CAREER DEVELOPMENT SYSTEMS. (American Education Research Association Annual Meeting, San Francisco, 1986).

_____. PAYING FOR BETTER TEACHING: MERIT PAY AND ITS ALTERNATIVES (Ithaca, NY: Organizational Analysis and Practice, 1986).

Hummel-Rossi, Barbara. EVALUATION OF THE MATHEMATICS AND SCIENCE RECERTIFICATION PROGRAM (NY: New York University, 1986).

Little, Judith Warren. "Norms of Collegiality and Experimentation: Workplace Conditions of School Success." AMERICAN EDUCATIONAL RESEARCH JOURNAL, Vol. 19 (1982), pp. 325-340.