DOCUMENT RESUME

ED 479 481 SP 041 710

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TITLE	Inservice: The Key To Reform?
PUB DATE	1999-10-00
NOTE	23p.; Paper presented at the Annual Meeting of the Mid-Western Educational Research Association (Chicago, IL, October 13-16, 1999).
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE	EDRS Price MF01/PC01 Plus Postage.
DESCRIPTORS	Educational Change; Elementary Secondary Education; *Faculty Development; *Inservice Teacher Education; *Mathematics Education; *Mathematics Teachers; Teacher Improvement

ABSTRACT

Results are presented from an exploratory study considering a comparison of NSF-funded professional development programs for inservice teachers related to mathematics education reforms of the 60s and the 90s. The research involved: identification of differences and commonalities existing between professional development programs for inservice mathematics teachers in these two eras; determination of how these programs are related to the comparable yet evolving forces, issues, and expectations related to the reforms and professional development; and ascertainment of implications for making future policy decisions concerning professional development funding. Projects from the 60s and 90s were found to differ in nearly every aspect of organization, content, and results. In each era, programs for professional development were found to directly reflect changing forces, issues, and expectations associated with mathematics education and professional development of the time. (Contains 35 references.) (Author/SM)

INSERVICE: THE KEY TO REFORM?

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Paper presented at the annual meeting of the Mid-Western Educational Research Association, Chicago, October 1999

ABSTRACT

Results are presented from an exploratory study considering a comparison of NSF-funded professional development programs for inservice teachers related to mathematics education reforms of the sixties and the nineties. The research involved: identification of differences and commonalities existing between professional development programs for inservice mathematics teachers in these two eras; determination of how these programs are related to the comparable yet evolving forces, issues, and expectations related to the reforms and professional development; and ascertainment of implications for making future policy decisions concerning professional development funding. Projects from the sixties and nineties were found to differ in nearly every aspect of organization, content, and results. In each era, programs for professional development were found to directly reflect changing forces, issues, and expectations associated with mathematics education and professional development of the time.

Running head: INSERVICE FOR REFORM

INTRODUCTION

Background: The Case For Comparing Two National Reforms

Over the past decade, mathematics education has geared up for major reform (see Mathematical Sciences Education Board [MSEB], 1990, 1991; National Council of Teachers of Mathematics [NCTM], 1989, 1991; National Research Council [NRC], 1989). Since the distribution of the National Council of Teachers of Mathematics *Curriculum and Evaluation Standards for School Mathematics* in 1989, *Professional Standards for Teaching Mathematics* in 1991, and *Assessment Standards for School Mathematics* in 1995 (hereafter referred to as *Standards*), changes have been initiated in classrooms from Kindergarten through college in curricula, teaching methodologies, and assessment techniques. Though teacher preparation programs have been responsible for introducing preservice teachers to the practice and spirit of these and similar documents, supporting long-range change, the promptness and breadth of the reform has been dependent upon the continuing education of the multitude of currently practicing teachers of mathematics. The updating and upgrading of teachers' knowledge of mathematics content, as well as the reorientation in their pedagogy and assessment, have been largely due to the participation of teachers in professional development programs, many of which have been funded by the National Science Foundation [NSF].

The national involvement and magnitude of this reform are reminiscent of the "new math" movement of the early sixties (see Krieghbaum & Rawson, 1969; NCTM, 1970; NRC, 1989; Nee, 1990; Ratner, 1992; Selden & Selden, 1994). The reforms have common external motivations: changes in technology, needs of the workforce, and discontentment with the mathematical preparation of school children. As is the case today, government,

business, industry, and higher education of 30 years ago were all calling for improvement in the quality of mathematics education. Internally, the desire to improve the curriculum provided motivation both then and now. Like today's *Standards* reform, the "new math" movement required fundamental changes in mathematics education across the country, from Kindergarten through college classrooms (Gates, 1995; NCTM, 1970, 1989, 1991; Nee, 1990). In both cases, extensive change has been needed immediately. Since the ultimate responsibility for the implementation of reform curricula falls on the practicing teacher (see Ball & Wilcox, 1989; Cooney, 1994; Davis, 1990; Ferrini-Mundy & Johnson, 1994; Fitzsimmons & Kerpelman, 1994; Kline, 1973; Krieghbaum & Rawson, 1969; MSEB, 1990, 1991; Miller, 1990; National Commission on Teaching & America's Future, 1996; NCTM, 1970, 1977, 1989, 1991; NSF, 1993; Nee, 1990; Phillips, 1996; Price, 1994; Ratner, 1992; Ravitch, 1983; Romberg, 1990, 1994; Staff, 1996; Weiss et. al. 1990), education for these teachers has played a significant role in the scope of each reform.

Purpose of this Study: Comparing Professional Development Practices

Thus, the study provides a fresh look at one particular component of mathematics education reform. Due to the national range of the reform movements, although many professional development programs are locally oriented, this study focuses on federal initiatives. With so much concern about our limited resources and the national deficit, it is imperative that we scrutinize federal budget allocations in all areas, including education. In fact, since education is actually the responsibility of the states rather than the federal government, discriminatory spending at the federal level is even more critical. Professional development programs are time-consuming and labor-intensive, thereby quite costly. Resources of federal agencies must be distributed so as to maximize the productiveness of our national investments.

In both eras, funding agencies such as the NSF have responded with requests for proposals whose programs provide such professional development for teachers. Moreover, in these particular eras, larger percentages of their award dollars have been designated for these reform-related programs (NSF, 1987, 1996). Though studies have looked at professional development programs of the National Science Foundation over the years (Fitzsimmons & Kerpelman, 1994; Weiss, Boyd, & Hessling, 1990), none consider a specific comparison of programs in these two revolutionary eras of mathematics reform.

The research questions guiding the study asked for the following: the identification of differences and commonalities existing between professional development programs for inservice mathematics teachers in these two eras; a determination of how the programs are related to the comparable yet evolving forces, issues, and expectations related to the reforms and professional development; and the ascertainment of implications for making future policy decisions concerning professional development funding.

Importance of a Historical Perspective

History provides a unique and valuable perspective. We can learn a great deal from the struggles and accomplishments of our professional forebears. Knowledge and understanding about practices of the past, whether considered successful or not, can be used to our benefit in designing and carrying out future plans (Mazuzan, 1988; Miller, 1990; NCTM, 1970; Scribner, 1984/1988; Stanic, 1983). In his 1995 keynote address to the annual meeting of the NCTM, marking the organization's 75th anniversary, Executive Director James Gates traced the history of NCTM's involvement in mathematics education. He discussed lessons learned from past endeavors, particularly citing concerns of and reactions to the movements of the sixties and seventies as important contributions to planning in the eighties, culminating with the *Standards*. He noted the value that reflecting

on the past has in preparing for the future, stating, "At this point in our history, we were less naive about change and its possibilities" (Gates, 1995, p. 7).

Examining the past aids us in maintaining a more global view of our present situation, thus allowing for more open-minded approaches and actions. Stanic (1983) states:

> Without curriculum history, we, in a sense, have tunnel vision of current problems; we see them in a restricted framework. Historical perspective provides not only a sense of the range of possibilities, but also a fuller comprehension of the consequences of particular actions. (p. 5)

This implies, when the circumstances and motivations are similar, as is the case in these two mathematics reform movements separated by three decades, it can be argued that studying and reflecting on the past is not only helpful, but actually necessary to avoid repeating past mistakes and engage in fruitful discussions for future reform decisions. "Only by a serious examination of our history can we determine the extent to which older educational practices are likely to succeed in today's environment for today's purposes" (Resnick & Resnick, 1977/1988, p. 120).

Policy makers clearly understand the importance of historical study. In the preface to his survey of the National Science Foundation, historian George Mazuzan (1988) states:

> An account of things past allows one to see broad themes that recur in the present and continue into the future. History does not repeat itself exactly, but events and issues of the past do have a tendency to reappear albeit in slightly different form. That is why the aphorisms, "Study the Past" and "What is Past is Prologue," carved into the entrance to the National Archives, are cited so often. Policy makers run the risk of "reinventing the wheel" when they make judgments on problems they face unless they are well informed about the context in which previous decisions of a similar nature were made, what alternatives were considered, why certain ones were chosen, and what personal and impersonal forces shaped a particular policy. Thus history can be a useful component of sound public policy. (p. ii)

Good decisions concerning the policies of agencies which determine funding allocations should necessarily consider the past in preparing for the future.

Review of the Literature

A review of the literature considered several factors highlighting and contributing to the differences and commonalities of the two reform movements and the related concerns for professional development of practicing teachers. These factors fall into three subheadings: the forces contributing to the genesis of the reform movements, the issues related to mathematics education reform, and the expectations related to professional development for practicing teachers. The results of the review are summarized in tables comparing the sixties with the nineties for each of the three subheadings.

	60s	90s
Technology explosion	Focus on national impact • Sputnik • Arms race	focus on personal impact • computers/calculators • communications
Employment needs	Advanced mathematics for the few; basic skills for most	good estimation and problem solving skills for all
International concerns	Focused on Cold War with the USSR	total world economy
Mathematical literacy	College bound students	population at large
Psychology of learning	Deductive approach	Constructivism

Table 1: Summary of Forces Contributing to the Genesis of the Reform Movements

	60s	90s
Reform planning	top-down approach	collaborative effort
Teacher professionalism	Teachers given reform directives	teachers plan and direct change
Curriculum shift	both moving away from separate topical areas, mechanics and memorization to unifying themes, problem solving, and understanding	
Mathematical topics	Probability and statistics recommended	data analysis and discrete math strongly recommended; more diversity of topic areas
Pedagogy	not emphasized (focus on mathematical content)	variety in methodologies, student-centered approach
"Equal" education	Assumes common learning style and experience (white, college-bound males)	recognizes multiple learning styles and experiences (diversity in needs, culture, gender, etc.)

Table 2: Summary of Issues Related to Mathematics Education Reform

	60s	90s
Policy makers	help teachers prepare future mathematicians	help teachers raise general mathematical literacy
Business & industry	help teachers prepare researchers and upper-level managers	help teachers improve all future employees' problem solving skills
Funding agencies	Increase content knowledge for individual teachers	provide total teacher development; develop leadership for networking
Institute providers	Promote continuing education and degree programs	promote systemic reform
School systems	Increase content knowledge for individual teachers	develop leadership for networking
Teachers	Increase content knowledge	provide connections to the classroom
Society at large	(few expectations due to lack of reform information)	aid teachers as responsible professionals

Table 3: Summary of Expectations Related to Professional Development for Practicing Teachers

PROCEDURES

Sampling and Data Collection

Selection of Time Periods

Five-year spans were selected to reflect the evolving nature of reform. Because the initial *Standards* document was published in March of 1989, the period covering the National Science Foundation's fiscal years 1990-94 (October 1, 1989-September 30, 1994) was chosen as the time interval for study of the latter reform. Though the "new math" reform at the secondary level began in the mid to late fifties, elementary reform did not take hold until later, with experimental institutes first offered in 1959. As such, the 1960-64 period of fiscal years (July 1, 1959-June 30, 1964) was selected so as to include all levels, K-12. Moreover, the "new math" reform push in the early sixties can be seen in the

212% increase in the NSF education budget in 1959 (NSF, 1987, p. 5). The difference in calendar months for the two eras is due to a 1976 change in the Foundation's determination of their fiscal year dates.

Although annual reports and other pertinent documents were studied from multiple years, funded projects were only sampled from the final year of each time period. This was primarily due to limited availability of information from the sixties, preventing the determination of which projects addressed mathematics in the first four years. The nineties' period was limited accordingly, by the researcher.

Sources and Data Types

The research looked for evidence concerning several factors related to funding professional development programs for inservice mathematics teachers, such as teaching level, content focus, target audience, staffing, duration, funding, evaluation, and dissemination. The intention was to collect common items from the two eras, for a direct comparison. However, despite earlier phone and e-mail contacts with NSF personnel, visits to the NSF revealed that only limited information was available.

The primary sources for the research related to the reform of the sixties were the staff, in-house library, and archives of the National Science Foundation in Arlington, Virginia and the National Archives in College Park, Maryland. Items available for study included NSF annual reports, minutes of division meetings, a limited number of funded project documents, and other miscellaneous documents from a variety of government agencies (e.g., Library of Congress, National Science Board [NSB], NSF, U.S. General Accounting Office).

The primary sources for the research related to the reform of the nineties were the electronic dissemination system of the NSF on the Internet, the staff and library of the NSF

in Arlington, Virginia, and project principal investigators from across the nation. Items available for study included NSF annual reports, NSF guides to programs and specific requests for proposals [RFPs] concerning professional development related to mathematics education reform efforts, documents provided by investigators related to funded projects, and other miscellaneous documents from the NSF.

Documents for specific funded projects in each era were the primary resource used in answering research question one, concerning differences and commonalities existing between NSF-funded professional development activities for inservice mathematics teachers during the "new math" era and corresponding activities during the period of the NCTM *Standards* related reform.

Samples for each period were intended to be quasi-random, and representative of the population for the given year. However, documents for both eras were quite limited in availability. Information was obtained for only 19 pertinent projects from fiscal year 1964 and 11 projects from fiscal year 1994. In order to get the broadest possible picture, each of these 30 projects was included in the study. Due to the lack of available information, the samples did not necessarily represent the demographics of their populations accurately.

A review of a variety of reports and publications from NSF gave insight into research question two, concerning the relationship of funded programs to the evolving forces, issues, and expectations associated with mathematics education reform and professional development.

All of the materials collected and summarized provided insights for research question three, concerning how such a comparative investigation informs policy makers for

future decisions about professional development programs for practicing mathematics teachers.

Data Analyses

Data was searched to identify themes throughout the professional development programs for practicing K-12 mathematics teachers, as related to the changing forces, issues, and expectations cited in the literature review. So as not to impose the bias of the researcher, the actual organization of the summary for the sixties and nineties was determined only after a thorough review of the data.

Annual reports were used to determine the National Science Foundation's official position on and funding levels for the professional development of practicing K-12 mathematics teachers. These reports provide context for such programs in relation to the other responsibilities, functions, and concerns of the NSF.

Documents from the particular divisions responsible for education activities within the NSF were used to gain insight into the NSF's role in responding to and/or influencing new stages in the evolution of factors affecting professional development for mathematics teachers. The policies of the NSF at the time are reflected in these documents, determining what projects were funded.

Meeting minutes from the sixties and guides to programs from the nineties were searched for themes summarizing the direction of the division in developing policy. Studying these documents yielded information on key policy shifts, as well as insight into areas of evolving understanding, related to professional development programs. They also provided information concerning the overarching goals and expected outcomes for professional development programs, choices for funding categories to support those goals, and desired project characteristics.

Information related to each specific funded project was reviewed to determine the design and conduct of professional development activities in the project, as well as expected and/or realized outcomes of the project. Preliminary information from the sixties' awards listings and the nineties' abstracts was verified or corrected as necessary, including the following: project title, sponsoring institution, school level, and amount of NSF funding. Additional information was recorded in four categories: project, staff, participants, and resources. Project information includes location, focus, contents/events, follow-up activities, assessment procedures, and outcomes. Staff information was recorded concerning their professional qualifications. Participant information includes their characteristics/qualifications, selection process, number attending, and amount of support provided. Data was summarized and compared to find overall commonalities and differences in professional development activities between the two eras of mathematics reform.

Other documents collected from each era were searched to fill in missing information or to clarify information gathered through project files, education division documents, and annual reports. These additional documents also served to verify the themes which emerged in the analysis of the other items.

RESULTS AND CONCLUSIONS

Research Question One: The Comparison

What differences and commonalities exist between NSF-funded professional development activities for inservice mathematics teachers during the "new math" era and corresponding activities during the period of the NCTM Standards related reform?

In both eras of reform, professional development programs funded by the National Science Foundation were offered in nearly every state. As might be expected, the percentage of funded projects was higher in more densely populated regions of the country, and lower in the more sparsely populated areas for both reforms. Aside from the similarity in geographic distribution across the nation, NSF-funded professional development programs in 1964 and 1994 differed considerably in nearly every other aspect of their organization, content, and results. These comparisons are summarized in three tables.

Table 6 summarizes the comparison of the organization of professional development activities:

	60s	90s
Sponsor	institutions of higher education	higher education, schools, boards of education, private agencies
Location	higher education campus	campus & schools
Planning	university mathematicians	Collaborative effort: university mathematicians & educators, teachers, private industry
Principal Investigators	university science & mathematics professors	co-investigators from multiple fields
Staffing	university mathematics professors	mathematics & education professors, teachers, administrators
Design	mathematics coursework	coursework & classroom laboratory
Participants	individuals; focus on secondary level	teams; focus on K-12; target teachers of students from underrepresented groups
Funding	100% NSF; support for many projects at relatively low cost	cost-sharing; support for fewer projects at relatively high cost

Table 6: Summary of organizational comparison of sample professional development projects in the sixties vs. the nineties.

Table 7 summarizes the comparison of the content of professional development activities:

	60s	90s
Field	57-58% of institutes for mathematics teachers only	
Project focus	improve teaching quality by upgrading content knowledge	improve teaching quality by addressing content, pedagogy, assessment, & leadership
Content/events	lecture mathematics courses (theory); passive participants	inquiry-oriented mathematics courses (applied); active participants; classroom lab; workshops for curriculum & pedagogy; study of educational research
Follow-up	none (essentially)	built into academic year with support structures

Table 7: Summary of content comparison of sample professional development projects in the sixties vs. the nineties.

Table 8 summarizes the comparison of the results of professional development activities:

	60s	90s
Expected outcomes	• improved teaching & preparation for new curricula (by improving content knowledge) • obtain higher degrees • increased student enthusiasm & participation	• standards-based curriculum implementation • increased use of manipulatives & technology • teacher role change • leadership development • increased collaboration of schools & community • increased student enthusiasm & participation
Directors' reports	• demographic statistics • note participant enthusiasm • effect on pre-service program • note needs: teacher-oriented staff; more cohesive programs; follow-up; structured networking	• demographic statistics (including "indirect effect" & time spent on pedagogy) • formative use • note participant enthusiasm • effect on other college programs • note importance: lab phase; collaboration; high expectations
Evaluation reports	no requirements for formal evaluation in design	variety of requirements: quantitative & qualitative; teacher, students, & school; formative & summative

Table 9: Summary of results comparison of sample professional development projects in the sixties vs. the nineties.

Research Question Two: The Context

How are these programs related to the changing forces, issues, and expectations associated with mathematics education reform and professional development?

Forces Contributing to the Genesis of the Reforms

Reports and publications of the National Science Foundation document the response to the forces contributing to the genesis of the reforms, in both the content and delivery of professional development programs of the sixties and the nineties. In each case, the reasons for the NSF's involvement, the focus of their efforts, and their approach to solving the problem were all in concert with the forces driving the reforms.

Reasons for involvement. In these two eras, perhaps more than at any other time in our history, the nation was focusing on two distinct, yet related goals for science and mathematics education: to fill the nation's human resource needs in science, mathematics, and engineering; and to improve the scientific literacy of the citizenry. As a federal agency, the Directors of the NSF in both eras noted the Foundation's obligation to consider these goals as they related to its mission.

Focus of efforts. Increasing the scientific workforce requires having a large pool of interested and talented students majoring in mathematics and the physical sciences. To give all [college-bound] students the opportunity to pursue a scientific career and to ensure scientific literacy of the entire [college-educated] public, a common curriculum including advanced mathematical topics seemed an appropriate response, and was supported by Foundation efforts.

The technological advances of the nineties dictated special training for new skills needed not only in the scientific workforce, but in the general workforce as well. As the gaps were closing in the mathematical needs required for work and college, focus shifted to

an education using a curriculum which closes the gaps in opportunities for all students. All proposals in the nineties required attention to equality of access to science and mathematics education.

Approach to solving the problem. The limited backgrounds of many high school teachers in the sixties did not equip them for adequately challenging and preparing talented students for the rigors of college science and mathematics programs. As such, many teachers needed to learn mathematics themselves before they could teach the concepts in the new curricula. At the time of the earlier reform, little was known about the process of learning. Though the lack of connection of these programs to classroom practice was a concern for participants and project directors, there was little research to support making widespread changes to the approach which was in practice at the time.

In the nineties, on the other hand, the mathematical preparation of most teachers was much more advanced. The reduced need for content allowed time for attention to methodologies. The growing body of educational research related to the psychology of learning supported the notion of constructivist, student-centered approaches to teaching and learning mathematics, and has accordingly altered the approaches to professional development activities.

Issues Related to Mathematics Education Reform

In both eras, the notion of reform was assumed to be rooted in a curriculum shift toward a focus on unifying themes, problem solving, and understanding. How to implement that reform was clearly viewed differently in the two reforms, based on the prevailing opinions concerning the issues involved.

First, concerning planning, the top-down approach of the sixties was a natural extension of the view of scientists as the authorities on what should be taught and how it

should be taught. Without a body of research to support other approaches, the reluctance to collaborate with educators is not surprising. Planning of the nineties not only recognizes multiple authorities in the field of mathematics education, but takes a stronger position by requiring cooperation, collaboration, and partnering between the fields of mathematics and education, as well as among all levels of the educational process.

A particular group excluded in the planning for the reform of the sixties was the teachers themselves. Given the limited training of many teachers at that time, this is neither unexpected nor unwarranted. By the nineties, this networking had become an integral part of professional development programs. Increased certification requirements, in both mathematics content and in educational studies, had greatly enhanced the status of teachers, and leadership training became a central focus of the nineties' projects.

As has been noted, the focus on traditional mathematical content was necessary in the sixties' reform. The nineties indicated a more applied approach to a more diverse group of topics. In addition, pedagogy was not emphasized in the sixties, partly due to the lack of a research base concerning more appropriate or effective methodologies than the traditional lecture. In the nineties' reform, a variety of methodologies aimed at a student-centered approach were not only discussed, but actually modeled by the project staff in the courses and training the participants were experiencing.

Finally, with little research in educational psychology, the approach of the sixties assumed a common learning style and experience for all students, reflected in the similarity of programs for professional development. In the nineties, the NSF requires potential projects to address the diversity in learning styles based on cultural, gender, and other differences in the population of students served. Even the projects themselves represented a diversity of activities and styles.

Expectations Related to Professional Development for Practicing Teachers

In both eras, nearly all constituencies concerned with education recognized the key role of the classroom teacher in implementing reform. What differed were their expectations for the professional development programs, as was seen in the study of the projects themselves and the reports and documents of the NSF.

In the sixties, the Congress played a key role in professional development programs, as it was Congressional requirements for minimum funding levels of the NSF programs which mandated the incredible number of programs available. Though there is little mention of federal government in the documentation studied from the nineties, the systemic reform projects indicate the desire to collaborate in aligning policy and practice in education.

Though business and industry played a role in professional development programs prior to the NSF's involvement in the late fifties and early sixties, they apparently stepped back when the NSF took the lead. In the nineties, however, the NSF expects the involvement of local industry and business in planning and supporting professional development for their teachers, as employment needs target good problem solving abilities at all levels of hiring.

The National Science Foundation itself was primarily concerned with improving teachers' subject-matter knowledge in the reform of the sixties, with increasing discussion of the need for institutionalizing, networking, and providing structure for ongoing professional development to sustain change. By the nineties, these were all natural expectations for professional development projects. In addition, the NSF now requires a variety of evaluation procedures and activities to assure progress and improvements, as well as teacher leadership, in mathematics and science education with each new project.

The difference in institute providers for the two reforms naturally yields differing expectations for the projects they support. In the sixties, the NSF only supported projects provided by institutions of higher education. These providers promoted continuing education and degree programs for participants, resulting in increased enrollments. The institute providers of the nineties, including local school districts not funded in the previous era, tended to promote systemic reform projects and other projects supporting widespread, lasting change.

Both school systems and their teachers desired increased content knowledge from the professional development programs of the sixties, although the teachers indicated a need for structure and guidance in applying theory learned in their own classrooms. School systems of the nineties expected leadership development for networking professional development throughout the system in an expeditious and cost-effective manner. Teachers expected connection of theory to classroom practice and collaboration with peers to provide a support system for implementing and sustaining change.

Finally, the society at large was primarily left in the dark in the sixties, as little was communicated beyond the lessons brought home by students. In the nineties, professional development projects include parents and other community sectors in planning, to keep lines of communication open and promote changes in policy when needed.

Research Question Three: The Connotation

How does such a comparative investigation inform policy makers for future decisions concerning professional development programs for practicing mathematics teachers?

The evidence shows that the professional development programs of both reform movements responded to the evolving forces, issues, and expectations of the times. The reform of the sixties did not last, though this does not lessen the success of the Institutes

Program itself. The objective of that program was to improve the subject-matter knowledge of teachers, and that was clearly accomplished. However, the assumption that reaching this objective would, in and of itself, result in the successful implementation of a curricula the teachers had not planned, was simplistic at best, and more likely faulty.

In contrast, the programs of the nineties are defined more broadly, overlapping in both scope and function. They reflect the complexity of the educational process as it is understood today, and was only beginning to be understood in the sixties. The objectives are many, and the process long, but this time the structures have been built into the process for constantly reevaluating and revising programs as research would suggest. The evidence shows that the NSF has taken serious note of the past in developing this present policy. The seeds for understanding the requirements of implementing lasting reform were planted in the sixties, through the comments and suggestions of those critical to the process, the teachers themselves. They have considered all facets of the complexity of the educational process and built into the system the web of support necessary for accomplishing the objectives of facilitating teacher change in both practices and attitudes. In addition, evaluation projects are imbedded in the individual projects, as well as for assessment of entire programs. This allows for reflecting on and revising practices while they are in progress, and best practices to be replicated in other settings.

Will the changes last? Have we truly begun to implement complete and pervasive reform? If so, will we see a positive effect on student achievement as a result of reform? Though only time will tell, it seems the answers to the first two questions are both affirmative. If NSF and like agencies continue the cooperative efforts begun in this decade, with evaluation constantly informing decisions for revisions and replication procedures, the reform has a chance to survive the critics.

Policy makers must continue to listen to the past, whether 30 years past or just days ago, in choosing the best practice projects for funding. Collaboration of all players and continual evaluation are key. Dialogue across all levels of the educational spectrum must continue to inform institutions of higher education about programs for preservice teachers, if the reform is to continue to build energy and support. Finally, local schools and school districts must get involved and align themselves with the available projects, to ensure pervasive reform of mathematics and science education.

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