

The National Science Foundation and a Comparative Study of Precollege Mathematics
and Science Education Reform in the United States, 1950-2000

By

Emily Timmons Hamilton Redman

A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

History

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor Cathryn Carson, Chair

Professor John Lesch

Professor Alan Schoenfeld

Fall 2013

Copyright © Emily Timmons Hamilton Redman

All rights reserved

Abstract

The National Science Foundation and a Comparative Study of Precollege Mathematics and Science Education Reform in the United States, 1950-2000

by

Emily Timmons Hamilton Redman

Doctor of Philosophy in History

University of California, Berkeley

Professor Cathryn Carson, Chair

The history of math education reform is fragmented and must be placed in conversation with the history of science education reform, as both are better understood when considered in parallel rather than historically conflated. The early coherency of the math education community permitted it to capitalize on post-Sputnik funds—mainly supplied by the National Science Foundation (NSF)—in a wholly different manner than that in science education. Over time, the NSF’s role in education was curtailed by changing federal administrations, competing agency, rising internationalism, and unsettled questions of democracy. By directly comparing the histories of math and science education reform I question the general narrative of educational reform in modern American history and replace it with a more focused examination of their individual rhetorical strategies, thus providing a more suitable historical context for ongoing discussions of reform efforts.

DEDICATION

"Dr. S. V. Clevenger, Alienist and Neurologist, July 1890, describes an infant prodigy, Oscar Moore. Two little colored children were reciting the multiplication table at their home, in a little cabin in Texas, as they had repeatedly done before, and one of them asserted that four times twelve was fifty-eight, whereupon a thirteen-months old baby, Oscar Moore, who had never spoken before, corrected the error by exclaiming, 'Four times twelve are forty-eight!' There was consternation in that humble home until the family became reconciled to the freak."

From G. Stanley Hall. *The Pedagogical Seminary*. (Worcester, MA: J.H. Orpha, 1891), 300.

* * * * *

Though certainly not a prodigy, I did share Oscar's childhood interest in calculation, consistently pestering my parents, Robin and Len, to scribble out arithmetic "quizzes" to keep me occupied at the dinner table, on long car trips, and everywhere in between.

Nevertheless, they seem to have become reconciled to me. In fact, they even encouraged me to be odd.

This dissertation is dedicated to my parents, who supported all of my odd behaviors and tangents (not least of which being mathematical wordplay) even as I changed over time. I couldn't have made this trajectory without you.

$$\frac{\Delta}{t}$$

Equation 1

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION	1
CHAPTER 2: FROM GRASSROOTS TO GOVERNMENT GRANTS: THE MATHEMATICS EDUCATION COMMUNITY AND SUPPORT FOR REFORM: 1950-1975	20
CHAPTER 3: THE ANTHROPOLOGY OF REFORM: MACOS AND A SHIFTING ROLE FOR MATHEMATICS EDUCATION REFORM AT THE NATIONAL SCIENCE FOUNDATION	59
CHAPTER 4: ASSESSING THE NATION: MATHEMATICS EDUCATION REFORM AND THE MARCH TOWARD NATIONAL STANDARDS OF STUDENT ACHIEVEMENT AND EDUCATIONAL ASSESSMENT	90
CHAPTER 1: WAKE UP AMERICA! YOUR CHILDREN ARE AT RISK: MATHEMATICS EDUCATION REFORM IN AN AGE OF ANXIETY IN AMERICA	124
BIBLIOGRAPHY	158

CHAPTER 1

INTRODUCTION

The history of math and science education reform in the United States is one that popularly begins at the 1957 launch of Sputnik, when the United States increased funding for science, implemented standardized tests, offered scholarships, and undertook a complete overhaul of national educational standards. The history then accelerates through a heyday of federal funding of a myriad of curriculum reform efforts that eventually sputtered in the wake of perceived failures of these reforms, were reinvigorated by *A Nation At Risk*, and ultimately solidified in the flurry of standardized testing in the late twentieth century. It is popularly a history structured by the federal government, with legislation such as the National Defense Education Act (NDEA) and the Elementary and Secondary School Act (ESEA) providing the framework for any school reforms. It is a history that conflates math and science—all of the sciences—to tell a story of education reform in the nation's classrooms.

This history is not exactly wrong, yet it fails to take into account the historical particularities of the mathematics education community and how this community contributes to—and challenges—the larger history of math and science education reform in the second half of the twentieth century in the United States. Though its members cannot be characterized as maintaining unanimous agreement as to the direction of reform throughout this period, the mathematics education community does provide a unified front of sorts, with participants generally agreeing on the basic structure of reform and many of the steps needed to practically enact it in the classroom. Crucially, this community was not born out of the crisis-laden atmosphere of post-Sputnik fears; the mathematics education community coagulated at the turn of the twentieth century, spurred by external pressures threatening the longstanding position of mathematics in the precollege curriculum, and increasing internal pressure to modernize the curriculum to better address both content needs and pedagogical concerns.

In the first half of the twentieth century the mathematics education community grew in strength and numbers, effecting small-scale change, engaging in community-wide dialogue, and exploring long-lasting relationships with the professionalizing field of experimental psychology that was beginning to offer suggestions to problems of learning and cognition applicable to the classroom. This model would evolve, however, with wartime experiences shifting the societal perceptions of the importance of mathematics. Less than a year after the attack on Pearl Harbor, professional literature began to emerge from the mathematics education community discussing plans for postwar mathematics instruction at the precollege level, as math educators (and most Americans) were convinced that the war had, and would continue to, demonstrate the usefulness of mathematics and thus its importance in the precollege curriculum.¹ By mid-1944, the National Council of Teachers of Mathematics (NCTM) issued its first official report on post-war plans, including recommendations for improved content. The question

¹ Garret, Alan W. and O. L. Davis, Jr. "A Time of Uncertainty and Change: School Mathematics from World War II Until the New Math." In Stanic, George M. A., and Jeremy Kilpatrick, eds. 2003. *A history of school mathematics*. Vol. 1. 2 vols. Reston VA: National Council of Teachers of Mathematics, 509.

remained, however, how to mobilize public opinion and increased interest from Washington into tangible, widespread reform. Of course, such a great task was one that would require “the united effort of a homogenous group” [See Ch. 1]; the continued call for organization only increased as the need for reform seemed to many to be more necessary than ever. One educator led the cry: “Teachers of mathematics, especially at the high-school level, will need to rally all their resources of influence and persuasion if the war is to result in any permanent improvement of the sadly neglected mathematical education of the general public.”²

Following World War II, bolstered by both popular opinion that students’ mathematical abilities were insufficient for modern needs as well as a slight uptick in available funding, the mathematics education community expanded efforts to coordinate a change in the precollege curriculum. By the launch of Sputnik and the respondent launch of federal funding streams for reforming math and science education, the mathematics education community was organized and prepared to capitalize on the new resources.

The history of mathematics education reform from Sputnik, through the new math in the 1960s, and to the heavy reliance on standards at the end of the twentieth century is primarily recorded in the historical literature in one of two ways. First, it is part of a larger story of math and science education reform that focuses on federal structures and sociopolitical influences and fails to recognize the unique characteristics of the mathematics education community in this context.³ Second, the history of mathematics education reform, if presented as separate from science education reform, is often presented as either a relatively unhistoricized narrative⁴ or as a history of a series of reactions to external influences, often with reform efforts painted as being stunted or unduly impacted by such factors.⁵ A small amount of literature depicts the mathematics education community as tailoring discourse to immediate sociopolitical concerns, resulting in a failure to produce any long-term solution to what is viewed as a continuous problem in precollege mathematics instruction, rather than allowing for an evolving conception of the problem itself.⁶

What these historical narratives fail to do is situate the mathematics education community in a two-way dialogue with these external factors, giving the community itself autonomy and agency in effecting change in the classroom and in the educational policies and practices in the United States. The story of mathematics education reform in the United States must be considered alongside science education reform, as for much of the period from 1950 to 2000 decisions and funding were made that encompassed both areas. Yet the precollege mathematics education community influences this overall

² Ibid., 510.

³ The literature on math and science education reform in the Cold War is extensive. One of the best examples is John L. Rudolph, *Scientists in the Classroom: The Cold War Reconstruction of American Science Education*, (New York: Palgrave, 2002). However, despite the text’s (many) merits, mathematics education is not treated separately from the sciences.

⁴ A number of memoir-type accounts exist, particularly from the new math era.

⁵ For an example see Lappan, Glenda and Jeffrey J. Wanko. “The Changing Roles and Priorities of the Federal Government in Mathematics Education in the United States.” In *A History of School Mathematics*, vol. 2, edited by George Stanic and Jeremy Kilpatrick, 897-930. Reston VA: National Council of Teachers of Mathematics, 2003.

⁶ For an example see James T. Fey and Anna O. Graeber, “From the New Math to the *Agenda for Action*,” in *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick, (Reston VA: National Council of Teachers of Mathematics, 2003).

history in distinct ways—it influences not just the narrative of math education, but of the conflated math-and-science reform that is shaped by state, local, and federal legislation and funding—and therefore its history must be considered as a separate influence if we are to understand U.S. math and science reform more generally.

Mathematics education reform in the United States should not be understood as the efforts of a small (if determined) community of reformers, working within the limitations (or, more optimistically, the structure) imposed by the federal government and the American educational system. Instead, the history of mathematics education reform should be understood as the conscious relationship between a small, determined, and relatively coherent community of reformers with the federal structures and resources that support reform. Mathematics education reform cannot be divorced from the sociopolitical milieu in which it unfolds, but care must be taken to not dismiss it as merely a passive receiver of these influences. Instead, a close reading of the history of mathematics education reform shows a ready adaptability to the changing climate and a concurrent development of both reform principles and symbiotic relationships to deploy them. This should not necessarily render the mathematics education community as shallow, shamelessly bending to external pressures to further its goals. Rather it demonstrates the ability of the community to work within the changing milieu of the twentieth century, attune to politics, popular opinion, and evolving educational structures, fostering productive relationships and itself shaping the direction of larger educational policies in the United States.

This dissertation explores the mathematics education community as it evolved throughout the period 1950 to 2000. During this time, the community remained a relatively unified front, even as individual members sparred and reform efforts varied in terms of both content and method. Yet the community remained in constant, productive dialogue and functioned as a separate intellectual entity from external factors, while at the same time remained able to work within the changing structures of educational policy and federal funding. The ability to remain autonomous and coherent even as the backdrop against which reforms were enacted allowed the mathematics education community the agency to be an active partner in the history of reform in the United States.

This dissertation begins with a history of the development of the mathematics education community as it arose at the beginning of the twentieth century. Fearful that mathematics would lose its traditional place in the precollege curriculum, a growing number of people voiced interest in seeking reforms. The community grew, and small-scale reform efforts were undertaken. At the same time, the mathematics education community found a bedfellow in experimental psychology, with each discipline borrowing from the other in its own professional development. The first chapter ends with the post-WWII era, when new concerns at the federal level and among the population fueled a major overhaul in math and science education in the nation's schools. The second chapter explores the ways in which the mathematics education community worked alongside the National Science Foundation (NSF). The Foundation, established in 1950 and charged with responsibility to support the nation's research and education in math and science, served as the primary arm of the federal government to disseminate funding for educational research and development; following Sputnik this funding would rapidly increase and the NSF would control the purse strings of most of the nation's educational reform efforts in precollege math and science. In the first few decades

following the establishment of the NSF, the mathematics education community generally worked alongside and in the same framework as the science education reform community. As the heyday of NSF education funding wound down by the late 1960s and early 1970s in response to both increased questioning of the efficacy of the flurry of reform programs and a larger cultural shift away from progressive reform, the mathematics education community found itself increasingly self-reliant and without backing from the federal government. This reaches somewhat of a climax in 1975, when the mathematics education community is internally reevaluating the reform efforts of the previous two decades, and the NSF finds itself mired in controversy that results in a sharp reduction in educational programming. The third chapter explores this controversy as a case study in the history of mathematics education. During the strong years of precollege curriculum reform the NSF funded a social sciences curriculum project known as Man: A Course of Study (MACOS), which ultimately came under fire for both its questionable content and the relationship of the NSF to the dissemination of the curriculum to the nation's schools. While this controversy would lead the NSF to remove itself from course content improvement programs, the mathematics education community offered convenient ways in which the Foundation could maintain a foothold in precollege education reform despite sharply reduced funding and a general air of conservatism coloring education policy and progressive reform. The fourth chapter follows the evolving relationship between the mathematics education community, which comes to be led by different segments of the community in these years, with the NSF. The longstanding relationship between mathematics education and educational psychology continues into this period, ushering in both new types of reform efforts and alternate sources of accountability for programs. At the same time, the tradition of undertaking large-scale evaluation of curriculum programs and student achievement positioned the mathematics education community as a central model for the increasing demand for assessment and measurable objectives. By the end of the twentieth century, the mathematics education community demonstrably helped usher in a new era of federal involvement in education. The final chapter steps back to explore in more depth the sociopolitical climate of national fears and how this impacted the role of mathematics education reform as a part of the larger education policies in the United States.

Edward G. Begle, a mathematician best known for directing the School Mathematics Study Group (MSG), a prominent curriculum reform project in the “new math” era, is quoted in 1971 as saying, “[m]athematics education is much more complicated than you expected even though you expected it to be more complicated than you expected.”⁷ Its history, too, is more complicated, interrelated, and more widely influential than one might expect, particularly if taking the popular history outlined above as a starting assumption. This dissertation extracts the history of precollege mathematics education reform from the larger history of education reform in the United States. It does so by outlining the coherence and autonomy of the mathematics education community, yet at the same time recognizing that this community is both influenced by externally imposed structures and is an active partner in the evolving nature of educational reform and policy in the United States.

⁷ Edward Begle, “Research and Evaluation in Mathematics Education,” *Report of Conference on Responsibilities for School Mathematics in the 70's*, (Stanford: MSG, 1971), 30. As quoted in Geoffrey Howson, Christine Keitel, and Jeremy Kilpatrick, *Curriculum Development in Mathematics*, (Cambridge: Cambridge University Press, 1981), 195.

This dissertation focuses on curricular development, which embodies the aims, content, method, and assessment of classroom teaching and learning—though the emphasis on each aspect varied considerably with each project and at certain times. The fundamental process of curriculum development can be described in quite simple terms; Thomas A. Romberg, Professor Emeritus of Curriculum and Instruction at the School of Education at the University of Wisconsin-Madison published this simple hierarchical chart [Fig. 1] outlining the general process:⁸

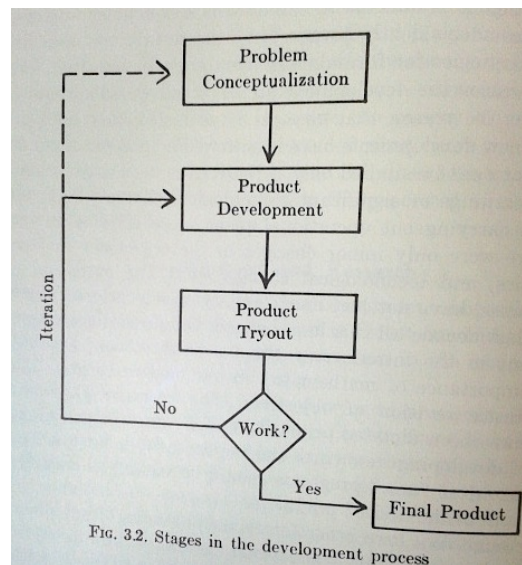


Figure 1

Certainly, this looks simple enough: figure out the problem (school mathematics is outdated, not serving the needs of students, workplace, or nation), develop a product (textbooks and other curricular material for use by the instructor and in the classroom), try out that product (send it to various school districts for use and observation), and then determine if it works (assessment). If it works, the problem is considered successfully solved. If it is decided that the product does not work, the curriculum developers start over, either with the conceptualization of the problem itself or with another attempt at developing the product.

While this model might work on a small scale, when understanding the longer *history* of curriculum reform, the small rectangle of “final product” offers the sticking point. Curriculum reform efforts were born out of a concern that content and pedagogy were outdated, and that the needs of students and the population were changing. Of course, these external changes are continuous, with the “recipients” of reformed curricula—students, teachers, parents, school districts, state boards of education, federal administrations, and international relationships—continue to evolve; so too must any “final product.”

Consider an additional comparison offered by Romberg, which likens the overall organization and influential parties of curriculum reform to the organization of a factory:⁹

⁸ Thomas A. Romberg, “Curriculum, Development, and Research,” in National Council of Teachers of Mathematics, *The Teaching of Secondary School Mathematics: Thirty-third Yearbook*, (Washington, DC: National Council of Teachers of Mathematics, 1970), 62.

⁹ Romberg, “Curriculum, Development, and Research,” 58.

Level	Planners	Product	Examples
DESIGN Board of Directors	National Committees	Intended Learning	Reports from College Entrance Examination Board, Cambridge Conference
BLUEPRINT Vice-President	Publishers Curriculum Groups	General Operational Plan	SMSG
CONSTRUCTION Shop Foreman	Curriculum Committees	Systems Plan	Developing Mathematical Processes
UTILIZATION Worker	Teacher Instructional Team	Lesson Plans	

In this example, Romberg traces the hierarchy of process as beginning with a general description of the main content areas that should be covered in a curriculum—this begins with national committees who issue broad statements and recommendations. Next, smaller curriculum groups convene to determine detailed lists of content areas, as well as what order these topics are to be presented and what resources are needed to implement the curricula. The third level further organizes content and also considered methods of teaching and how the student will interact with the curriculum. Finally, the curriculum goes to the instructor, where the needs of the individual student are accounted for.

Romberg's analogy is fairly apt, though of course not all curriculum development projects follow this exact pattern. What is missing from the comparison to the factory, however, is the context in which the factory itself is running. Does the local population approve of the product? Does the industry approve of the means of production? Is it financially sound? Are there larger moral or ethical questions relating to the functioning of the factory? Will the factory be able to modify its product for a changing marketplace? Will federal regulations (say, on emissions, wages, and benefits) ultimately topple the factory or will it adapt to external factors? These questions need to be addressed before ensuring the success of the factory, and so too must similar questions be asked of reform efforts. Just as the factory cannot be understood as a stand-alone entity, precollege mathematics education reform cannot be understood as distinct from the cultural and political backdrop in which it operates. This dissertation situates the mathematics education community in this context, as an entity that at once functions independently, within, and for a particular context—a context, too, that experiences change over time.

Romberg's analogy, too, implies the necessity of a shared vision across all levels, from the board of directors to the worker on the factory floor. What happens, though, if change is desired? One way the modern factory evolved to address differences in opinion—particularly when they straddle divisions of power within the factory structure—is through the establishment of unions that seek to provide a coherent, unified front to push forward interests and work to foster communication and, ideally, cooperation among all levels. Taken another way, the average individual worker at a factory would be unlikely to have his or her voice heard should change be desired. Even if that worker organized with a dozen or so sympathetic colleagues, their voices could easily be drowned out. Yet if the workers organize to present a coherent voice that represented the interests of all members (even if individual differences of opinion would certainly exist within its ranks), the likelihood of direct communication is much higher than if a cacophony of voices expressed varying interest in change.

In the mathematics education community, of course, there are no unions. The reform movement, too, cannot be considered monolithic, yet the community for the most part offered a strong, unified, and coherent vision for pushing forward shared interests—namely the firm conviction that the “traditional” mathematics curriculum needed to be replaced, and furthermore the people to develop that replacement should come from “expert influence” within the ranks of the community. This community had definitive leadership, as well—one participant in curriculum reform referenced the vocal leadership of the mathematics education community as, good-naturedly, the “math mafia,” a nod to the strong organization, swift action, and forceful opinions of the group.¹⁰

Crucially, this community—and its mafia—infiltrated all levels of the “factory,” from the classroom teacher all the way to the national committees that set forth recommendations. Though some strained relationships were felt within the ranks, in general the unofficial membership in the community allowed for equal rank, whether the member be an elementary school instructor, a college mathematics professor, or an experimental psychologist. The leadership, too, drew from all corners of its membership. In the early years of the reform effort, leadership came primarily from university professors of mathematics or education, making prominent individuals and professional organizations such as the Mathematical Association of America (MAA) influential in directing reform. Over time, however, leadership shifted to include the classroom teacher, and subsequently organizations such as the National Council of Teachers of Mathematics (NCTM) took the leadership role in guiding reform. Such shift in leadership did not, in the case of the mathematics education community, indicate faults in the coherence of the group. Instead, such shifts demonstrate the flexibility of the group to adapt to external factors. James C. Herbert, one time executive director of academic affairs at the College Board—a position in which he oversaw six Academic Advisory Committees that were responsible for curriculum recommendations for various subject areas, one such committee made up of representatives from the “math mafia”—described the pervasive unity of the group as it being his sense that it was “such a coherent community that laps over various organizations that they decide, we’re going to do this [particular reform strategy], and then they say now which would be the right organization [to take the leadership role in effecting it].”¹¹ This coherence, Herbert argues, is “real power,” and comes from continued reinforcement of shared values within the community:

I mean people [in the mathematics education community] talk and talk and talk in all kinds of fora. They all have different kinds of connections. And they come to lots of agreements. And they say this is working and that isn’t working, so there’s kind of a rolling consensus. And sometimes there’s a sharp issue like calculators in math or the oral proficiency interviews in foreign language teaching. But there just really is a lot of people who talk to each other. A professional community.¹²

¹⁰ James C. Herbert, *Work in K-12 Education Reform: Student Competencies, Curriculum Assessment, and the Language of Reform*, an oral history conducted 2012, Regional Oral History Office, The Bancroft Library, University of California, Berkeley, 2012, 17. Interview conducted by author.

¹¹ Ibid., 45.

¹² Ibid., 25.

Herbert sees this type of coherence as unique, at least in terms of comparison with the scientific community more broadly, where he claims curricular reform uniformity broke down because “[s]omehow the [science] pedagogy people didn’t mix it up with the content people.”¹³ Such coherence or organizational consensus, of course, does not in itself assure action. Yet the mathematics education community was able to, throughout the twentieth century, mobilize to push forward action in the form of classroom reform, at times at a national level. Herbert argues it was because they “knew the system,” and were able to capitalize on this knowledge by applying careful pressure:

Well, they knew the system. They knew how it worked, they knew. And of course there’s another big difference. Everybody thinks they know history. And nobody— And everybody thinks they don’t know mathematics. So it’s easier [for the mathematicians] to claim a certain amount of deference and secret knowledge and all that. But they were just politically good. They knew, they just knew hundreds of people in the schools of ed and the people who taught the undergraduate courses in colleges.¹⁴

Often, “knowing the system” is understood to be a negative, leading the knower to (knowingly) abuse the system in an effort to further one’s own goals. Yet knowing—and working within and for—the system is often crucial for success (or at least survival), be it a factory or a system of school mathematics reform. Even as the mathematics education community recognized the larger context of American culture, politics, and education and adapted its strategies based on changes in this context, this should not be seen as a necessary fault. In their history of mathematics education reform, Alan W. Garret and O. L. Davis characterize the community as routinely justifying the importance of mathematics in the curriculum, but then failing to “develop fully, carefully, and logically their case as more than a capricious reaction to the immediate world situation.”¹⁵ It is argued here that such a characterization does not allow for a recognition of the full agency of the mathematics education community, as a factor in the very changes to the “immediate world situation.” It also does not allow for changes *within* the community that might call for a change in response. The mathematics education community necessarily works within a much larger, much more volatile sociopolitical climate at the school level, and at the state, local, and federal level. Adaptability, then, can be understood not as an indicator of the structural weakness of the community, but rather as demonstrative of its coherent strength and wider influence in the history of reform in the United States.

Building Coherence: The Mathematics Education Community in the early 1900s.

“A popular benchmark [to begin a history of mathematics education reform] is Russia’s orbiting of the first sputnik in 1957. Much longer historical perspectives are needed if we

¹³ Ibid.

¹⁴ Ibid., 22-23.

¹⁵ Garrett and Davis, Jr, “A Time of Uncertainty and Change,” 494.

would understand present practice.”¹⁶ --Myron Roszkopf, professor of mathematics, 1970

To fully understand the development of the field of mathematics education, the attitude of the mathematics community toward education must be historically outlined. The rapid expansion of the educational system in late nineteenth century America led to widespread dissatisfaction with the curriculum, including that of mathematics. At that time there was a general recognition that traditional education of the nineteenth century must be replaced, that there “must be a well-accepted reason for teaching algebra or else the subject must be discarded, and similarly for the other mathematical disciplines.”¹⁷

E. H. Moore, the retiring president of the American Mathematical Society (AMS), spoke before the AMS in December of 1902 and called for the mobilization of professional mathematicians to help justify the place of mathematics in the curriculum, as well as to begin the reform of elementary mathematics:

The pure mathematicians are invited to determine how mathematics is regarded by the world at large, including their colleges of other science departments and the students of elementary mathematics, and to ask themselves whether by modification of method and attitude they may not win for it the very high position in general esteem and appreciative interest which it assuredly deserves.¹⁸

Such an invitation encouraged the initiation of discussion about curriculum reform efforts as it might influence the general perception of mathematics in the curriculum. Furthermore, such discussion, Moore suggested, would best happen with greater cooperation between secondary schools and colleges, which might include conferences that would discuss the improvement of both secondary school curricula and college entrance requirements.¹⁹ Moore actively directs his audience to form a coherent community to the problem of school mathematics reform, recommending that:

All persons who are, of may become, actively involved in this movement of reform [of school mathematics] should in some way unite themselves, in order that the plans and the experience, whether of success or failure, of one may be immediately made available in the guidance of his colleagues.²⁰

How such a community might unite was left to the imagination of the audience (though Moore indicated that conferences might be a good start), but he continued to emphasize

¹⁶ Myron F. Roszkopf, “Mathematics Education: Historical Perspectives,” in National Council of Teachers of Mathematics, *The Teaching of Secondary School Mathematics: Thirty-third Yearbook*, (Washington, DC: National Council of Teachers of Mathematics, 1970), 3.

¹⁷ David Eugene Smith, “A General Survey of the Progress of Mathematics in our High Schools in the Last Twenty-Five Years,” in The National Council of Teachers of Mathematics, *The First Yearbook: A General Survey of Progress in the Last Twenty-Five Years*, (1926), 7.

¹⁸ Eliakim Hastings Moore, “On the Foundations of Mathematics,” in The National Council of Teachers of Mathematics, *The First Yearbook: A General Survey of Progress in the Last Twenty-Five Years*, (1926), 44.

¹⁹ *Ibid.*, 54.

²⁰ *Ibid.*, 55.

the dimension of the problem: “That there is need for the careful consideration of such questions [of the reform of school mathematics] by the united body of experts, there is no doubt whatsoever.”²¹

As Moore was suggesting a reevaluation of the elementary school curriculum, primarily in response to a widening popular opinion that school subjects should directly train students for practical life—a theory known as the social efficiency model—others were becoming deeply concerned about the high school mathematics curriculum. One of the most common concerns vocalized was the perceived inability for the secondary schools to provide proper training for college-bound students. At the beginning of the twentieth century, colleges operated as autonomous entities, each requiring quite different things from entering students. The secondary schools found it impossible—save for “pedagogic acrobatics” that were “rare to the point of non-existence”—to adapt curricula to the varied demands of multiple colleges. In a 1925 address, one observer remarked “the situation would have been comic were it not so preposterous.”²² Mathematics played a central role in these discussions; though the use of entrance examinations was not widespread at the time, when colleges did employ them these exams were exclusively focused on measuring students’ mathematical abilities due to its adaptability to standardized testing: “Although set by such a large number of different examining bodies, the subject matter was fairly uniform, based as it was upon a tradition that was generally known throughout the country.”²³

To address the problem of incongruity between the high schools and colleges, the College Examination Board was organized in 1900, which helped create uniformity in entrance standards and in turn helped secondary schools better tailor curricula to the needs of colleges. Yet the first requirements reported by the College Entrance Examination Board (CEEB) were met with criticisms that the colleges were assuming undue rights in dictating the curriculum in the secondary school.²⁴ In response, in 1902, the American Mathematical Society (AMS) formed a committee on the definitions of college entrance requirements. The recommendations provided were thorough—suggesting that students should be tested on logarithms, theory of equations, determinants, complex numbers, etc.—yet not precise, allowing for the content and structure of subsequent tests to be quite varied.²⁵ In the ensuing years more and more professional mathematicians and mathematics educators vocalized their views on the proper content of the secondary school curricula and how best to prepare students for college. In 1915, in part due to a growing concern about the high school and collegiate curricula, the Mathematical Association of America was founded, with the choice of president being E. R Hedrick, professor of mathematics at the University of Missouri with interests in research, collegiate mathematics, and secondary education.²⁶ The following year he appointed the National Committee on Mathematics Requirements (NCMR) to make a careful study of:

²¹ Ibid., 54.

²² Smith, “A General Survey of the Progress of Mathematics,” 1. The words come from the president of the NCTM.

²³ Ibid., 2.

²⁴ Ibid., 4.

²⁵ Ibid., 2.

²⁶ Eileen F. Donoghue, “The Emergence of a Profession: Mathematics Education in the United States, 1890-1920,” in *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick, (Reston VA: National Council of Teachers of Mathematics, 2003), 183.

the purposes which should determine the teaching of mathematics in our secondary schools and suggested a syllabus which should eliminate non-essentials, retain those things which should best meet the needs of pupils of the present generation, and introduce such modern material as should strengthen the work without attempting to make it unreasonably difficult.²⁷

Yet despite an increasing coherence of a mathematics education community, the philosophy of social efficiency continued to hold sway with many in the United States. In 1915, William Herd Kilpatrick, one of the most influential progressive education leaders in the country, was asked by the National Education Association's (NEA) Commission on the Reorganization of Secondary Education to chair a committee to study the teaching of secondary school mathematics. Kilpatrick ultimately recommended doing away with tradition and modifying the curriculum for nearly all students to be more utilitarian in a 1920 report.²⁸ The mathematics community was incensed, not least because many leveraged the claim that Kilpatrick authored the report independently, without input from committee members, who were argued to be in name only. At the very least, the mathematics community voiced its dissatisfaction with not being contacted for their opinion on the matter.²⁹ Many felt that the profession needed a unified voice to defend against interlopers.³⁰ Though the MAA created its National Committee on Mathematical Requirements, mathematics teachers were largely excluded from membership, though increasingly this group demanded a say in the ongoing debates about what would be taught in their classrooms. At a 1920 conference of the NEA a group of educators met and began the formation of the National Council of Teachers of Mathematics (NCTM), an organization that would have continued influence throughout the remainder of the twentieth century, and would increasingly work alongside efforts at the MAA and other professional mathematics organizations.³¹

The mathematics teachers nearly immediately had their voices heard, with the 1922 revisions of the CEEB requirements that, this time around, represented the combined judgment of colleges and secondary schools.³² The recommendations were seen at the time to be radical, suggesting that schools excise “useless and uninteresting work” and instead focus on useful applications to science and business.³³ The student was no longer to focus on an array of abstract problems, but instead “devote his energies to the solution of those types which have some chance of being used.”³⁴ The professional mathematicians, too, continued to have a say in the ongoing discussion; in 1923 the MAA's NCMR released its report, *The Reorganization of Mathematics in Secondary Education*, which clearly delineated the aims of mathematics instruction in the junior high and high school. Though Kilpatrick's 1920 report continued to hold sway among those interested in education reform, the NCMR was widely circulated and “available in most high school and public school libraries in this country,” and influenced many early

²⁷ Smith, “A General Survey of the Progress of Mathematics,” 4.

²⁸ David Klein, “A Brief History of American K-12 Mathematics Education in the 20th Century,” in *Mathematical Cognition*, edited by James M. Royer, (Greenwich, CT: Information Age Publishing, 2003), 179.

²⁹ Ibid., 180.

³⁰ Donoghue, “The Emergence of a Profession,” 186.

³¹ Ibid., 187.

³² Smith, “A General Survey of the Progress of Mathematics,” 4.

³³ Ibid., 10-11.

³⁴ Ibid., 11-12.

reform efforts. The report presented model courses and made suggestions for carrying out the work of altering the curriculum, as well as discussing the merits of experimental courses in mathematics and standardized testing.³⁵

Building a Program of Testing

In 1908 the section on philosophy, history, and instruction of the International Congress of Mathematicians pushed forward the development of an International Commission on the Teaching of Mathematics. In the United States, numerous reports were prepared—by 1920 the Commission had produced nearly 300 publications³⁶—on topics such as mathematics in the elementary schools, in public and private secondary schools, the training of mathematics teachers, and influences tending to improve the work of the teacher of mathematics, and mathematics curricula in various countries.³⁷ The reports were widely circulated, leading to an increasing recognition that American schools were “distinctly behind other countries.”³⁸ This contributed to the discussion of reforming the mathematics curriculum in the United States, but it also demonstrated the need for large-scale assessment of educational practices and achievements, on small and large scales. Though the data collected by the International Commission was unsophisticated and remained relatively unanalyzed, it marked a beginning in the movement to organize testing and assessment, particularly through the compilations of extensive data.³⁹

Some of the first tests developed in the beginning of the twentieth century remained smaller in scale, assessing student achievement in arithmetic in (and increasingly across) classrooms. These tests “accomplished much in the improvement of the work in arithmetic, in diagnosing pupils’ difficulties, and in the measurement of their capacities,” and these successes helped propel the development of more tests for other mathematical subjects like in algebra and geometry that focused on the later grades.⁴⁰ By the mid-1920s, such tests were routinely given to wide swaths of students, both for college entry as well as for pure research. In 1926, the retiring president of the NCTM, Raleigh Schorling, outlined one such study in which an “Inventory Test” of 125 elements was given to thousands of junior high school pupils to determine their mathematical competency.⁴¹ The analysis of such tests was used both to justify the need for further reforms of the curriculum, as well as bolster a spirit of competition that would support such reforms. Following in the heels of the International Commission’s reports that characterized U.S. mathematics education as dangerously trailing that in Europe, Schorling paints a picture of the inequity of the American system:

Many European visitors to our schools, though they may be enthusiastic about many excellent characteristics, are vigorous in their indictment

³⁵ Ibid., 9.

³⁶ Jeremy Kilpatrick, “A History of Research in Mathematics Education,” in *Handbook of Research on Mathematics Teaching and Learning*, edited by Douglas A. Grouws, (New York: MacMillan, 1992), 7.

³⁷ Smith, “A General Survey of the Progress of Mathematics,” 7-8.

³⁸ Ibid., 8.

³⁹ Kilpatrick, “A History of Research in Mathematics Education,” 7.

⁴⁰ Smith, “A General Survey of the Progress of Mathematics,” 19.

⁴¹ Raleigh Schorling, “Suggestions for the Solution of an Important Problem that Has Arisen in the Last Quarter of a Century,” in *The National Council of Teachers of Mathematics, The First Yearbook: A General Survey of Progress in the Last Twenty-Five Years*, (1926), 61.

expressed in such phrases as: ‘You foster half learning’; ‘You are satisfied with low standards’; ‘You do not fix habits’; and ‘There is no question that you can ask your children that any considerable number of them will know.’⁴²

Despite the use of such tests to make larger, dramatic, claims about the need for reform, it was quite clear by the 1920s that the widespread introduction of standardized testing in the United States was “accompanied, in a great many places, by grave misuses,” including wrongful judgment of the quality of a teacher based on the outcome of the test, or inaccurate comparisons among individuals.⁴³ Though standardized tests were understood to have helped develop certain, definable standards of achievement which could measure student learning and help inform future reforms, it was clear that methods of testing needed to be vastly improved before useful analysis could be made. A suggestion for such an improvement was outlined by W. D. Reeve in the *First Yearbook* of the NCTM. In his essay, Reeve urges the development of a new form of testing “where the emphasis is placed upon a method of procedure in testing rather than upon any single test itself.”⁴⁴ In part he makes this argument because he believes more work needs to be done in the reform of the curriculum before testing will be of much use. He urges that the mathematics education community should first determine the abilities it wishes to measure before emphasizing the standardization of tests. “This does not mean that no measuring should be done in the meantime,” Reeve makes clear, “but rather that our methods of measuring should be improved before we seek to increase the use of standardized tests.”⁴⁵ For many, it was clear that an improved system of measurement required going outside of the mathematics community and seeking input from experts in experimental psychology and educational research.

Research in Mathematics Education: Partnerships with Psychology and Educational Theory

While mathematicians in the early twentieth were not wholly aligned with psychology, there was a growing professionalization in this area occurring in parallel with the growing community in mathematics education. Mathematics was very early on recognized as a popular vehicle to use in investigating learning, primarily due, as one historical study suggests, to “perceptions regarding its important role in the school curriculum; its relative independence of non-school influences; its cumulative, hierarchical structure as a school subject; its abstraction and arbitrariness; and the range of complexity and difficulty in the learning tasks it can provide.”⁴⁶ Early twentieth century experimental work on the psychology of reasoning included tests of physical and mental processes assumed to be symptomatic of degrees of intelligence, although in the first decades of the 20th century, results remained inconclusive. Empirical work focused on arithmetic processes, as work in higher mathematical processes was considered too complex for traditional empirical studies. Despite the focus on elementary mathematics,

⁴² Ibid., 64.

⁴³ W. D. Reeve, “Improvement of Tests in Mathematics,” in The National Council of Teachers of Mathematics, *The First Yearbook: A General Survey of Progress in the Last Twenty-Five Years*, (1926), 113.

⁴⁴ Ibid., 106.

⁴⁵ Ibid., 118.

⁴⁶ Kilpatrick, “A History of Research in Mathematics Education,” 5.

educators could not easily find practical application for the emerging studies, even when results looked promising. By the end of the first decade of the 20th century, it was clear that practical mathematics pedagogy was definitively complicated; a 1910 article in *Biometrika* concluded that it had become “more and more apparent in educational circles” that while education deals with the development of reasoning, in the classroom this training cannot function independently of the subject material.⁴⁷ By the 1920s more and more in the mathematics education community began to see the value of looking to this research to inform curriculum reform and improved methods of testing student learning.

Some of the earliest research in psychology that came to have great influence on mathematics education reform was that of E. L. Thorndike, who conducted a series of experiments beginning in 1901 that introduced the use of the control group in educational research. These experiments, conducted with Robert Woodworth, demonstrated the limited ability of mathematical skills to “transfer” to other applications. They showed, for example, that mastery of determining the sizes of sides of a rectangle did not impact a learner’s ability to judge the sides of a triangle.⁴⁸ Thorndike published his views in a series of mathematics texts published in 1917 and then in *The Psychology of Arithmetic* (1922) and *The Psychology of Algebra* (1923). While many mathematicians were dissatisfied, recognizing that it meant that traditional justification for the value of mathematics in the curriculum was being questioned, his theories nevertheless influenced curricular reform. In particular, Thorndike stressed the importance of creating “mental bonds” to material through practice and stimulus-response, which led to a series of follow-up experimental programs on drill and practice.⁴⁹

Thorndike would remain an influence on the mathematics education reform in the twentieth century, though later he would be for the most part replaced by the behaviorism, Gestaltism, and constructivism of such figures as Jean Piaget, Jerome Bruner, and Robert Gagné. But Thorndike’s work in mathematics education helped usher in a flurry of experimental activity within psychology and education that continued throughout the century. By 1924 the number of published studies in education on arithmetic was greater than those on reading, and by 1970 it was widely understood that “no other school subject has even approached the level and frequency of studies conducted in the area of arithmetic.”⁵⁰ It was clear within the mathematics education community that educational researchers were rapidly “becoming more acutely aware of the problems which need solution and are beginning to recognize in the subject of arithmetic a productive field for research.”⁵¹ Increasingly, too, those in the mathematics education community were becoming acutely aware that these studies were of practical importance when it came to reform. By the mid-1920s many agreed that, “[c]urricula can no longer be built on the pronouncement of authorities. The major need is for

⁴⁷ William Brown, “An Objective Study of Mathematical Intelligence,” *Biometrika* 7:3 (1910), 353.

⁴⁸ Kilpatrick, “A History of Research in Mathematics Education,” 9.

⁴⁹ *Ibid.*, 10.

⁵⁰ L. S. Schulman, “Psychology and Mathematics Education,” in *Mathematics Education (69th Yearbook of the National Society for the Study of Education)*, edited by Edward Begle, 23-71, (Chicago: University Press, 1970), 25. As quoted in Jeremy Kilpatrick, “A History of Research in Mathematics Education,” in *Handbook of Research on Mathematics Teaching and Learning*, edited by Douglas A. Grouws, (New York: MacMillan, 1992), 10

⁵¹ G. T. Buswell, “Curriculum Problems in Arithmetic,” *The National Council of Teachers of Mathematics, The Second Yearbook: Curriculum Problems in Teaching Mathematics*, (New York: AMS Reprint Company, 1966 (reprint)), 73.

experimentally determined facts. Only on the basis of such experimental evidence can the curriculum maker justify his recommendations.”⁵²

Not only, then, would testing be improved through consultation with social scientists, but so too would the curriculum itself. Through the research conducted in the early part of the twentieth century in psychology and education it was determined that almost every process in arithmetic was “far more complicated from the standpoint of its learning than has been assumed...the teaching of arithmetic as a science reported in methods books, courses of study, and textbooks formerly failed to recognize the difference between mathematical analysis and learning analysis of the processes taught.”⁵³ Many saw the work of experimental researchers offering value in the systemization and formulation of general laws of learning that could be applied to both content and pedagogy decisions in the reformulation of curricula.

The research on mathematics education was varied. Some examples include research done at the State Teachers College in North Dakota on pedagogical techniques for teaching long division,⁵⁴ and another on problem solving, undertaken at the University of Maine.⁵⁵ Numerous studies were conducted on drill and practice in classroom instruction, as were studies of the criteria for diagnostic tests of arithmetic.⁵⁶ While some research was experimental, other research was more purely quantitative. One such study, described by F. B. Knight in the NCTM’s *Second Yearbook*, was conducted at the University of Iowa by Frank L. Wells and E. A. Oleander. This study set up objective techniques for analysis of the instructional efficacy of elementary arithmetic textbooks, investigating both what was taught as well as how well the material was presented.⁵⁷ To assess textbook content across a range of textbooks, the researchers removed the instructional material dealing with whole numbers from seven different texts and displayed them in adjacent charts. One of the first things the researchers noticed was the wide range of sheer area of printed pages; the following table [Table 1] included in Knight’s essay is reproduced here.⁵⁸

AREA ANALYSIS OF INSTRUCTIONAL CONTENT DEALING WITH ADDITION OF WHOLE NUMBERS

For seven current arithmetic texts

TEXT	NO. OF SQ. IN. OF TOTAL AREA	NO. OF SQ. IN. OF PICTORIAL MATTER	TOTAL NO. OF WORDS	TOTAL NO. OF FIGURES AND SYMBOLS
A	91	2	570	267
B	92	28	370	157
C	82	12	266	427
D	78	19	373	256
E	128	40	401	311
F	133	22	810	656
G	527	63	3389	894

Table 1

⁵² Ibid., 93.

⁵³ F. B. Knight, “Some Aspects of Elementary Arithmetic,” *The National Council of Teachers of Mathematics, The Second Yearbook: Curriculum Problems in Teaching Mathematics*, (New York: AMS Reprint Company, 1966 (reprint)), 15-16.

⁵⁴ Ibid., 41-48.

⁵⁵ Ibid., 48-51.

⁵⁶ Ibid., 52-72.

⁵⁷ Ibid., 32.

⁵⁸ Ibid., 35.

This data was then further broken down to examine the amount of space devoted to four main features of the addition process, which the authors define to be the 100 basic facts of addition, higher decade addition, column addition, and vocabulary. This analysis, too, showed great variation in content of various texts.⁵⁹

While the kinds of research conducted in mathematics education certainly varied widely—they were experimental, quantitative, qualitative, conducted in classrooms and laboratories and research universities, based on particular topics or focused on theories of learning, and spanning the K-12 curriculum—the mathematics education community was forming a collective understanding that such research was practically useful to the larger concern of the reform of mathematics curricula. The partnership never became exactly equal; mathematics education expert Jeremy Kilpatrick characterizes the relationship as one where “[m]athematics educators have often been wary of psychological research because of what they have seen as an indifference to or ignorance of the academic discipline of mathematics, but they have never hesitated to borrow ideas and techniques freely from psychology.”⁶⁰ Yet despite a lack of complete integration of the fields, the foundation was firmly set in the beginning of the twentieth century to secure the importance of attention to learning theory, pedagogy, and evidence-based action in future years of reform.

Curriculum Reform and the Mathematics Education Community

Even as the mathematics education community was forming into a coherent entity, and even as the group struggled to answer questions about the relative importance of content and method, of appropriate topics and learning theory, curricular reform efforts were already underway. In his retrospective of the first twenty-five years of reform efforts, mathematician David E. Smith stated that the mathematics education community worked to set forth:

with greater clearness the aims which should guide in the teaching of each branch of mathematics...It has led to the elimination of much obsolete or relatively valueless material in arithmetic and algebra, to the introduction of new topics in each, to the merging of the first course in numerical trigonometry with the work in elementary algebra, to the elimination from geometry of matter of doubtful value, and to the general union of related parts of mathematics through such coordinating influences as that of the function concept and that of the social needs of our people.⁶¹

Smith particularly emphasizes the work done to reform algebra, which he regarded as “without exaggeration” being revolutionary.⁶² Smith denigrated the state of algebra instruction at the beginning of the century, claiming that it was taught as purely mathematical, “unrelated to life except as life might enjoy the meaningless puzzle” and most pupils “looked upon it as a fairly interesting way of getting nowhere.”⁶³ The

⁵⁹ Ibid., 36.

⁶⁰ Kilpatrick, “A History of Research in Mathematics Education,” 5.

⁶¹ Smith, “A General Survey of the Progress of Mathematics,” 30.

⁶² Ibid., 22.

⁶³ Ibid., 20.

reassessment of its presentation, as undertaken by “every leading writer of [textbooks of] school algebras,” revitalized the topic, according to Smith, making it more accessible, applicable, and generally interesting to the student.⁶⁴ Not only does Smith consider the reform of algebra revolutionary, but also he sees the collective efforts of the mathematics education community in curriculum reform to be unique and inspiring:

In no field of elementary or secondary education has advancement in the last twenty-five years been more marked than that in mathematics. If teachers feel discouraged with the reactionary attitude of certain administrators or of boards of control in state or city, they may well take courage by considering the state of high school mathematics at the beginning of the century and comparing it with the state of the subject at the present time.⁶⁵

Had Smith’s glowing endorsement been accepted wholesale among the mathematics education community, efforts at reform might well have stopped in the mid-1920s—Romberg’s “final product” might have been seen to be achieved. But the community was well aware that much more work needed to be done (and, grandiloquent language aside, so too was Smith). In February 1926 it was decided that the NCTM publish a second yearbook, this one on the topic of “Curriculum Problems in Teaching Mathematics,” due to the “present interest in curriculum revision.” The perspectives of a wide variety of interested parties were included in the next year’s publication, such as those of the psychologist, the classroom teacher, the college professor, and the school administrator.⁶⁶ Recommendations for specific content and pedagogy for the junior high and high school mathematics curriculum were included in this text, and were based on the growing number of studies in learning theory and experimental work on curricula. In the next few years, in part motivated by the “present interest in curriculum revision,” membership in the NCTM (and in the informal mathematics education community) exploded. Between 1927 and 1928 alone, NCTM membership increased from 3,000 to 5,000 members.⁶⁷ Subsequent yearbooks focused on varied aspects of the precollege curriculum for an ever-increasing readership. The 1929 yearbook described in detail the mathematics curricula, instructional materials, pedagogy, and various problems in mathematics instruction of various countries⁶⁸—from Czechoslovakia to Holland to Japan and Hungary—followed by a detailed description of the status of the mathematic curricula in the United States and a list of “depleting factors” that previously hindered reform efforts [Table 2].⁶⁹

⁶⁴ Ibid., 21-22.

⁶⁵ Ibid., 31.

⁶⁶ The National Council of Teachers of Mathematics, *The Second Yearbook: Curriculum Problems in Teaching Mathematics*, (New York: AMS Reprint Company, 1926), vii.

⁶⁷ William David Reeve, “United States,” in The National Council of Teachers of Mathematics, *The Fourth Yearbook: Significant Changes and Trends in the Teaching of Mathematics Throughout the World Since 1910*, (New York: AMS Reprint Company, 1966 (reprint)), 184.

⁶⁸ The National Council of Teachers of Mathematics, *The Fourth Yearbook: Significant Changes and Trends in the Teaching of Mathematics Throughout the World Since 1910*, (New York: AMS Reprint Company, 1966 (reprint)), vii-ix.

⁶⁹ Reeve, “United States,” 135-142.

The power of tradition	Acceptance of the status quo
Age to be respected	A priori acceptance of time honored content material
Domination of the college	Colleges “cling to medieval curriculum” with detrimental influence on school curriculum
The theory of mental discipline	Difficult content in schools is itself a good exercise
Transfer value of mathematics	Habits learned in mathematics can be applied to other fields of learning
Minimum essentials	Creating standards of mediocrity
Mathematics as a “tool subject	Social utility of mathematics
Emotionalized attitudes in learning	Impact of attitude on learning
Standardized Test	Misuse of measurement
Misuse of norms	Settling for “good enough”
The time fetish	Prioritizing the timed test
Poorly prepared teachers	Growth of secondary school enrollment accelerated problem
Requirements for teachers	Increasing employment requirements

Table 2

Such factors, the author argued, must be mitigated in future reform.

In the following years the NCTM continued to publish on the precollege curriculum. The fifth yearbook of the NCTM focused exclusively on the teaching of geometry, with fourteen essays on pedagogy, content, and method. The seventh similarly presented topics on algebra instruction, and the tenth on arithmetic. The sixth yearbook focused on “mathematics in modern life,” with essays on mathematics’ application to such fields as biology, agriculture, religion, and pharmacy. The *Eighth Yearbook* included an essay summarizing scientific investigation of high school mathematics in which the author cites more than 125 individual studies.⁷⁰ Specific topics in the curriculum were discussed at length in publications throughout the first half of the twentieth century, as were subjects such as the training of mathematics teacher (*Fourteenth Yearbook*, 1939), arithmetic in general education (*Sixteenth Yearbook*, 1941), and the theory and practice of learning mathematics (*Twenty-First Yearbook*, 1953). While a consensus might not have been growing about the direction for and resources needed for reform, the community of mathematics education had cohered around a shared concern for the need for reform.

Less than a year after the attack on Pearl Harbor, professional literature began to emerge discussing plans for postwar mathematics, as math educators were convinced that the war had, and would continue to, demonstrate the usefulness of mathematics. By mid-1944, NCTM had issued its first official report on post-war plans. One educator made the statement: “Teachers of mathematics, especially at the high-school level, will need to rally all their resources of influence and persuasion if the war is to result in any permanent improvement of the sadly neglected mathematical education of the general public.” The influence of the WWII experience on societal expectations is a critically important subject of its own. Chapter 5 takes up the rhetoric of mathematics and national competitiveness in detail.

In the immediate postwar period, a number of prominent figures came forward and made public their opinions about the declining rigor of American school

⁷⁰ H. E. Benz, “A Summary of Some Scientific Investigations of the Teaching of High School Mathematics,” in The National Council of Teachers of Mathematics, *The Eighth Yearbook: The Teaching of Mathematics in the Secondary School*, (New York: AMS Reprint Company, 1966 (reprint)).

mathematics. The public perception of the problem forced the issue to become one of legislation. By the late 1940s, many looked to this mathematics education community to offer solutions to the widely perceived problem of poor mathematical abilities among citizens. This concern was driven by the frequent reports of soldiers in World War II with insufficient mathematical abilities, the increase in remedial courses in the nation's colleges, complaints from employers about workers' readiness, and a general revaluation of the importance of math and science in society following the scientific and technological advances in the WWII era. Increasingly, members of the mathematics education community publically voiced opinion of the need for reform coming from within their community. A. J. Kempner of the University of Colorado wrote in 1948 that he blamed the "colleges of education and the administrative circles in the secondary school system" for the declining mathematical achievement in the country, suggesting that mathematicians and mathematics educators be a larger part of much-needed reform efforts.⁷¹ The time had come, it seemed to many in the United States, for a large-scale reform of math and science education in the nation's schools—importantly, one with emphasis on the content that was seen to have renewed interest to the American populace. Though it was well understood that "the united effort of a homogenous group of any sort has always proved to be one of the best methods of accomplishing great tasks," it was not until establishment of the National Science Foundation in 1950 until the structure for guiding such great tasks of reform came to fruition.

The remaining chapters of this dissertation will explore the way the mathematics education community worked in curriculum reform as a coherent entity across a shifting backdrop of cultural and political factors. Chapter 2 will explore the trajectory of reform efforts beginning in the lead-up to the new math era, and follow the shifting priorities and goals of the community as funding waxed and waned, additional research was made available, and public opinion forced adaptation. Chapter 3 will focus on the balance between internal coherence of the community and external factors limiting action in a case study of the MACOS controversy that greatly impacted NSF authority in math and science education. Chapter 4 will focus on the post-MACOS period, when leadership within the mathematics community shifted as a result of greater attention to pedagogical approaches, and the ways in which data collection and a tradition of testing within the mathematics education community shaped the future of education reform in the United States. Finally, Chapter 5 will explore the intersection of national anxieties about the Cold War and the nation's economy with shifting patterns of reform.

Throughout all of these chapters, the coherence of the mathematics education community is well documented. Though differences in opinion of course existed within this community, the unified front of the group helped the mathematics education reform of the second half of the twentieth century adapt to a changing cultural and political climate, but it also helped to shape the larger history of educational reform by offering a prominent model. Though the reforms undertaken in precollege mathematics curriculum during this period cannot—and should not—be viewed as wholly successful, a better understanding of the important role of the mathematics education community will enrich the larger history of education reform in the twentieth century United States.

⁷¹ Garrett and Davis, Jr, "A Time of Uncertainty and Change," 513.

CHAPTER 2

FROM GRASSROOTS TO GOVERNMENT GRANTS: THE MATHEMATICS EDUCATION COMMUNITY AND SUPPORT FOR REFORM: 1950-1975

This chapter explores the ways in which education reform became a matter of national policy and federal legislation in the second half of the twentieth century, though the shift to greater control from Washington did not always come easily. Specifically, it will explore the relationship of the mathematics education community, as it evolved from roots earlier in the century, and demonstrate how that community both maintained group autonomy and worked within a new structure of federal organization and funding. The chapter covers the period from 1950 to 1975, which spans the establishment of the National Science Foundation (NSF)—the arm of the federal government that comes to organize and fund the majority of precollege math and science education reform in the United States—until the time when nearly all funding for such programs is revoked as a result of both increased dissatisfaction with the types of curriculum reform enacted in the 1950s and 1960s, as well as a controversy that the NSF finds itself involved in over a particular course content improvement project [See Ch. 3]. This period is witness to the heyday of math and science education reform, yet by the late 1960 and early 1970s a number of factors contribute to the deceleration of larger school reform. In this chapter, however, it is argued that the coherence of the mathematics education community allows it to maintain an important autonomy that serves to protect the group—somewhat—from external factors such as decreased funding or public discord.

With the establishment of the NSF in 1950, the mathematics education community was organized, able, and prepared to capitalize on new funding streams available for curriculum reform, and it did so in a climate supportive of the reorganization of the precollege mathematics curriculum to better fit the needs of the American people. Early projects funded by the NSF built on an existing tradition of content analysis, assessment, and research. Crucially, though individual projects demonstrated a diverse array of approaches, methodologies, and underlying theories, the overall mathematics education curriculum remained a unified front—as proven by ongoing discussion about the nature of reform and the path of future efforts.

The period covered in this chapter is generally recorded as a history of math-and-science reform and, indeed, this is how, federally, the organization of reform is structured. Yet the very nature of the NSF funding supported the continuation of autonomy within mathematics education; primarily, curriculum reform projects were undertaken by groups with very little need to collaborate in other disciplines. A closer examination of this period underscores the importance of understanding mathematics education as separate from reform in other disciplines, as its very autonomy leads the mathematics education community to both “weather the storm” in the face of emerging external obstacles, and ultimately direct reform efforts independently—when necessary, at least—from the structures imposed by federal education policy.

This chapter will begin with a discussion of the organization of educational policy and the mechanisms for reform in the United States, with particular emphasis on how the National Science Foundation becomes involved in the precollege curriculum. It will

describe the relationship between the mathematics education community and its new benefactor in the NSF, and outline the mutual interests of the two groups. This chapter will explain how traditional interests in educational and psychological research influenced the massive reform efforts of the new math era, and describe the ways in which these interests ultimately guided an internal reassessment of mathematics education reform and shaped plans for future direction—a shift internal to the mathematics education community which ultimately coincided with a shift in the NSF’s work in education more generally. The chapter will conclude with a picture of the mathematics education community as remaining coherent through the peaks and valleys of education reform in the period 1950 to 1975; subsequent chapters will further explore the evolving relationship and mutual influence between the mathematics education community and the National Science Foundation as precollege education reform in the United States shifted over the course of the last quarter of the twentieth century.

Education in the United States: Tensions and Balance Between Federal, State, and Local

Despite an ever-widening web of authority over precollege education in the United States, “the myth of the little red schoolhouse continues to hold a cherished place in the country’s educational imagination.”⁷² This imagined center of intellectual development arises from a longstanding tradition of precollege education being primarily under the jurisdiction of local control. Though a strictly local authority was soon introduced to some district- and state-wide control, idealization of local school autonomy remains. Yet in the postwar era it became increasingly clear that widespread reform could only be undertaken with the help of federal support. How to organize that was a matter of deep contention dating back to early years in the nation’s history.

President Washington, in his message to Congress in 1796, proposed federal involvement in education by urging establishment of a national university:

Amongst the motives to such an institution, the assimilation of the principles, opinions, and manners of our countrymen, be the common education of a portion of our youth from every quarter, well deserves attention. The more homogenous our citizens can be made in these particulars, the greater will be our prospect of a permanent union; and a primary object of such a national institutions should be, the education of our youth in the science of government.⁷³

Just a few years later, in early 1800, education reformist Horace Mann spoke widely about the need to create a system to ensure that every student would receive free schooling, or a system of public education. At the time, opposition arose from people who felt that state truancy laws violated local prerogative to determine attendance policies.⁷⁴ As the nation’s educational system grew, increasing interest in and opposition

⁷² Bryan Shelley, *Money, Mandates, and Local Control in American Public Education*, (Ann Arbor: University of Michigan, 2011), 2.

⁷³ Erick L. Lindman, *The Federal Government and Public Schools* (Washington, D.C.: American Association of School Administrators, 1965), 9.

⁷⁴ Shelley, *Money, Mandates, and Local Control*, 2.

to federal involvement arose. Though often remembered as foundational in the establishment of higher education in the United States, at the time of the passage of the Morrill Act in 1862 it was viewed by states-rightists as an intrusion of the federal government. This opposition, too, was in large part an issue of curriculum, which the federal government effectively determined (or at least shaped), as it required certain courses of study to be made available.⁷⁵ Further opposition arose with the second Morrill Act of August 30, 1890, which implemented what would become known as “categorical aids” to education; it made clear that funds were only to be distributed to certain educational areas, and would not be distributed at all to schools that practiced racial discrimination.⁷⁶ This too was seen to be unjust intrusion into the individual autonomy of schools.

The federal government was becoming more involved in education in other ways, as well. In 1867, a federal education agency was established “to promote the cause of education.” This department operated as an individual agency until 1869, when it became an office of the Department of the Interior. It was called the Bureau of Education from 1870 to 1929, when it was renamed the Office of Education. Educational historian Erik Lindmann argues, “[t]he frequent change of name from department to office, to bureau, and back again to Office of Education, indicated the problem of finding the proper role and location within the federal structure for a federal education agency.”⁷⁷ Difficulty notwithstanding, the act that created the Office of Education dictated its responsibilities clearly and broadly:

collecting such statistics and facts as shall show the condition and progress of education in the several States and Territories, and of diffusing such information respecting the organization and management of school and school systems, and methods of teaching, as shall aid the people of the United States in the establishment and maintenance of efficient school systems, and otherwise promote the cause of education throughout the country.⁷⁸

Even with the success of establishing the Office of Education, the roots of opposition to federal control of education ran deep, with Constitutional arguments surrounding the general welfare clause of the Tenth Amendment cited as a legal barrier to use of federal resources to education the people of the respective states.⁷⁹

Despite deep-seated concerns about federal intrusion into education, for many years precollege education remained under local control. In the mid-1800s, states began establishing statewide public school systems, with local school boards having principal oversight until the early 1900s. At this time, fueled by concern that local school boards were too enmeshed in local politics, more centralized school boards consisting of fewer

⁷⁵ Lindman, *The Federal Government and Public Schools*, 9.

⁷⁶ *Ibid.*, 10.

⁷⁷ *Ibid.*, 10-11.

⁷⁸ *Ibid.*, 11.

⁷⁹ *Ibid.*, 8.

members and more strictly defined administrative positions began to emerge.⁸⁰ Still, during the first half of the twentieth century local revenue made up for more than 60 percent of the total funding for public schools.⁸¹ While conservatives and liberals alike championed this structure's ability to encourage parental participation and "dismantle the dehumanizing modern bureaucratic state," it became increasingly clear that variations in revenue sources led to deepening inequality among the nation's classrooms, requiring some sort of federal intervention.⁸²

With the end World War II inciting increased concern about the state of precollege math and science training, the classroom at once became a matter of national security and concern, which helped usher in new legislation that brought the federal government into the classroom [See Ch. 5]. In 1950, the National Science Foundation Act established the NSF as an arm of the federal government responsible for research, primarily, but supporting education was one of its missions as well. The reference to education in the founding charter of the NSF led the organization to develop a Division of Scientific Personnel and Education (SPE); Congress subsequently appropriated funds for the education aspects of the Foundation, which would be dispersed to grantee organizations who applied for funding of programs.⁸³ The NSF began to support education at all levels from kindergarten through graduate instruction.

In the early years, the NSF primarily focused on funding programs in teacher training, but it soon became clear that the curricular materials available to teachers were inadequate and outdated, a problem of increasing import with the explosive growth of knowledge after World War II. The NSF concluded that it was important "(1) to encourage the reappraisal of instructional materials at all academic levels by first-rate scholars and (2) secure and support their active participation in developing much improved materials. These materials, it was hoped, would be scientifically accurate and thoroughly sound, both conceptually and pedagogically."⁸⁴

Though the NSF's role in federal involvement in education was not without critics, the Foundation was able to enter this realm due primarily to three factors. First, the NSF was primarily seen to be responsible for the support of research in math and science; support of education was, in fact, understood to be a necessary component in supplying the necessary manpower to conduct this research. Second, the idea that the math and science needs of the country were so crucial was widespread, rendering the training of future mathematicians and scientists one of national interest, allowing for some acceptance of federal intervention. Third, the structure of the Foundation seemed to, at first, underscore the preservation of local autonomy in education, as the NSF would simply fund some aspects of education and not direct curricula specifically.

⁸⁰ Deborah Land and Sam Stringfield, "Educational Governance Reforms: The Uncertain Role of Local School Boards in the United States," in *International Handbook of Educational Policy: Part One*, edited by Nina Bascia, (Dordrecht, Springer, 2005), 260.

⁸¹ Shelley, *Money, Mandates, and Local Control*, 3.

⁸² *Ibid.*, 2.

⁸³ Lindman, *The Federal government and public schools*, 38.

⁸⁴ "Purpose, Scope and Nature of Activity," in National Science Foundation Education Divisions, "Status Report on the Course Content Improvement Activities of the National Science Foundation," March 1965, 2. NSB Commiss. on Precollege Education – Status Report on Course Content Improvement Act; Box 7; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

This model allowed the NSF to enter into education despite a long historical tradition of opposing any sort of federal intervention. The NSF trod carefully in its early years, aware of the sharp criticism it would draw should it overstep any boundaries. Yet the backdrop of cultural and political issues of the Cold War would rapidly increase the NSF's involvement in education, propelling it as a leader in curriculum reform and a de facto direct influence on the classroom. Ultimately, the perceived excesses of this involvement led to exactly that sharp criticism, and the NSF was forced to step back and reorganize its commitment to precollege education programming.

The NSF and Education: 1950 to Sputnik

At the 1950 establishment of the NSF, the mathematics education community was both prepared for action and cognizant of the import of the new Foundation on their work. In the same year, a Policy Committee for Mathematics was convened that represented the American Mathematical Society, the Mathematical Association of America, the Institute of Mathematical Statistics, and the Association for Symbolic Logic.⁸⁵ This group formed a Committee to Prepare a Proposed Budget for Mathematics for the National Science Foundation, which was submitted to the new Foundation to urge continued support of not just research, but also education. At the budget preparation meeting, the group recommended that a budget of \$20,000 be set aside to support a Special Commission of Mathematicians to survey the teaching of mathematics and the mathematics curricula in secondary schools. The report emphasized that “training at this level has long been a matter of concern to mathematicians and efforts should be made to investigate the situation and to recommend changes to improve it.”⁸⁶ In this recommendation the mathematics education community sought support for large-scale study of the secondary school mathematics curriculum—an extension of the community's years of previous, smaller-scale efforts. It also, importantly, recommended specific action in the choice of words recommending that changes should be made to *improve* the curriculum once a proper survey was conducted. The mathematics education community collectively understood that change in the nation's classroom could only be effected through “the united effort of a homogenous group”—with the establishment of the NSF's mission to support the nation's education in mathematics and science, the opportunity for action emerged. Though the Foundation would move slowly toward that aim, ultimately the vision from the mathematics education community would be seen to fruition.

Even as the NSF moved slowly, the mathematics education community continued to forge ahead in curriculum improvement research and development projects. Between 1950 and 1952, researchers at the University of Illinois determined that nearly 60 percent of students entering science and engineering departments had to take remedial courses in mathematics before beginning their studies. The researchers concluded that the problem lay in the secondary school curriculum that was not preparing students for the college curriculum and “those who knew modern development best, know the intricacies and

⁸⁵ Alan R. Osborne and F. Joe Crosswhite, “Reform, Revolution, and Reaction,” in The National Council of Teachers of Mathematics, *A History of Mathematics Education in the United States and Canada: The Thirty-Second Yearbook*. Washington, DC: National Council of Teachers of Mathematics, 1970, 256.

⁸⁶ A.A. Albert. “Report of the Committee to Prepare a Proposed Budget for Mathematics for the National Science Foundation - Preamble,” December 4, 1952, 4-5. Division for the Mathematical, Physical and Engineering Sciences, MATHEMATICS; Box 11; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

structure of their subjects, should help design courses and materials reflecting contemporary knowledge and points of view in appropriate ways.” Conveniently, the researchers at the University of Illinois fit that bill, and therefore began stage one of their process: the survey, with which it was quickly determined that few schools were teaching post-Newtonian mathematics. While this alone was understandably alarming to the university mathematicians, alongside this concern was one of more general pedagogy; also found distasteful was that “unvalidated assumptions about the levels at which pupils could learn specific things – the prejudices of the past – dictated the curriculum.”⁸⁷ With efforts made to investigate the situation of precollege education, the next step was to recommend changes to improve it, which developed through the formation of a university committee to guide experimentation on school mathematics, the University of Illinois Committee on School Mathematics (UICMS), established in 1951.⁸⁸

Though the NSF did not provide initial funding for the UICSM Project (this came from the Carnegie Corporation), the project came to represent one of the earliest coordinated efforts of the new math era—and, it should be noted, the NSF did provide the group’s later funding. “Discovery” teaching and learning—or a pedagogical method stressing student-guided inquiry—were hallmarks of the UICSM program, and these methods would come to dominate many of the new-math era curriculum programs of the late 1950s and early 1960s. The materials produced also reflected clear changes in content from traditional instruction, including an integrated four year program in which algebra was a continuous part, the minimization of geometry, the adaptation of trigonometry away from a separate subject and toward a more generalized presentation, the introduction of modern topics like set terminology, and the relocation of some topics—such as inequalities—to earlier in the curriculum.⁸⁹ This program, like many that followed it, stressed a dual emphasis on content and method of classroom instruction, and also allowed the mathematics education community to serve as a model for later curriculum development projects.

As UICSM was underway, the NSF was still feeling out its role and responsibility for precollege education reform. Some of the Foundation’s first efforts fell under the category of teacher training institutes, designed to update K-12 educators on the research and innovation in the sciences. Eventually, such institutes would also include training modules to help teachers utilize new curricular materials developed through NSF funding, but prior to this development the Foundation was required to find a niche in which it was comfortable effecting such change at the classroom level.

Finding this niche occurred in a piecemeal fashion. In July of 1953 the Assistant Director of the Division of Scientific Personnel and Education (SPE), Harry C. Kelly, wrote to Waterman to discuss plans for fiscal year 1954. In this memorandum, Kelly planted the seeds of a program in precollege education, though he still trod carefully in recommending a formal role for the Foundation. Work in precollege education, Kelly suggested, would not be a program in the sense of some other areas of NSF support, but rather take “account of existing opportunities to inform and encourage the qualified and interested youth of the nation who wish to consider science as a career. Last year’s grant

⁸⁷ Bowen C. Dees to Mr. R. H. Quirk, February 20, 1961, 2-3. Panel on Educational Research & Development (1962); Box 77; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

⁸⁸ Ibid.

⁸⁹ Osborne and Crosswhite, “Reform, Revolution, and Reaction,” 254.

of \$10,000 in support of Science Clubs of America is an example.” The budget Kelly recommended for work in precollege education asks for “one or two grants” making up \$15,000.⁹⁰ Paul E. Klopsteg, one of the original organizers of the NSF, later responded with some comments on the proposed program areas for fiscal year 1954, but did not have any comments (or, pointedly, any criticisms) about the work in precollege education.⁹¹

The example Kelly gives of the Science Clubs of America is an important one, as it indirectly enters the realm of precollege education reform, providing opportunity to interested students without directly interfering with classroom curricula. Of course, the interest in funding “existing” programs also gave precedent to education programs that were already coherent and underway—giving the mathematics education community somewhat of an advantage. Yet this sort of effort on behalf of the National Science Foundation was still not seen to be adequate in addressing what was understood to be national problem in K-12 education by mathematicians and by more and more scientists more generally. The sentiment among these scientists that formal programming should be initiated within the NSF to address the problems of precollege education was becoming so strong that a formal agreement for action was made. In November 1953, at the fifth meeting of the MPE Divisional Committee, it was “agreed that the National Science Board [NSB] should be advised that it is the feeling of the committee that the high-school teaching of mathematics and science is of such great importance to the scientific manpower and general welfare of the country that a national program should be developed to improve the situation.”⁹²

The understanding that action at a federal level was needed to address the national problem in precollege education began to spread throughout other areas of the NSF. By both the March 1954 joint meeting of the SPE Division and the Board Committee, as well as the August meeting of the NSB, “a number of Board members expressed the hope that the education in the sciences program can be developed into a more significant aspect of the Foundation’s total operations.”⁹³ Despite such support, however, the program in precollege education still struggled to maintain programmatic legitimacy and financial support from the Foundation. The allotted \$160,789 in fiscal year 1954 was estimated to be reduced to \$150,000 for the following year, a number made all the more disappointing to supporters of education reform in that the overall NSF appropriations nearly doubled during this time. Harry Kelly noted, too, that the Bureau of the Budget examiners would likely question such a decrease. Perhaps oddest of all was the budget estimate of \$500,000 allotted to the Education in the Sciences program for fiscal year 1956, a number so much higher than that of the previous year that it too would also seem questionable to

⁹⁰ Harry C. Kelly to Dr. Alan T. Waterman, “Research Education in the Sciences,” July 7, 1953, 4. Division of Scientific Personnel and Education, Research Education in the Sciences; Box 19; Records of the National Science Foundation, Office of the Director, General Records, 1949-63, RG 307; NACP.

⁹¹ Paul E. Klopsteg to Alan T. Waterman, “Research Education in the Sciences,” memorandum, August 3, 1953, 1. Division of Scientific Personnel and Education, Research Education in the Sciences; Box 19; Records of the National Science Foundation, Office of the Director, General Records, 1949-63, RG 307; NACP.

⁹² Minutes of the Fifth Meeting Divisional Committee for MPE Sciences, November 20, 1953, 4. MPE/MPS Divisional Committee Minutes 1952-1965; Box 39; Records of the National Science Foundation, NSF Agency Historians Files, RG 307; NACP.

⁹³ Harry C. Kelly to Dr. Alan T. Waterman, “FY 1955 Estimate for Education in the Sciences Program,” memorandum, August 25, 1954, 2. Division of Scientific Personnel and Education, Research Education in the Sciences; Box 19; Records of the National Science Foundation, Office of the Director, General Records, 1949-63, RG 307; NACP.

the Bureau of the Budget examiners. Kelly recommended that the fiscal year 1955 allotment be amended to at least match the previous year's allotment, if not increase it.⁹⁴ Two days later, on August 27, 1954, Waterman increased the fiscal year 1955 budget to \$190,000.⁹⁵

Though the NSF began its efforts in precollege education with the training of K-12 teachers, by the mid-1950s it was clear to both the NSF and other branches of the public and private sector⁹⁶ that “authority to develop and encourage the pursuit of a national policy for education in the sciences requires and justifies a great range of activities.”⁹⁷ One of these areas of policy would be in curriculum reform.

The mathematics education community continued to be omnipresent in the NSF's early education programming, particularly, at this time, through the MAA, an organization well suited to collaboration with the NSF in its standing as primarily an organization of professional mathematicians. The MAA, for instance, established the first visiting scientists program—an NSF-funded project that sent working mathematicians into K-12 classrooms—and it was also among the first to sponsor a summer institute for K-12 teachers. The MAA also made early headway in the development of tangible curricular materials as the first of the professional societies to submit a proposal to the NSF for the development of instructional films. By the mid-1950s, the NSF began to fund some conferences that brought together people interested in tackling the problem of curriculum in precollege education—once again the MAA was at the starting gates. One of the first such conferences was held in August 1956 by the MAA's Committee on Mathematical Personnel and Education, a group that aimed to consider “additional ways and means of promoting education in mathematics and the recruitment of mathematicians,” beginning from the earliest classroom exposure.⁹⁸

Despite a lack of clear direction for how, legally and non-controversially, the NSF could approach the precollege education, interest in gain a greater foothold in precollege education arose within a number of NSF Divisions. Certainly, the MPE Division maintained strong interest in such programs, as did the SPE Division—some clashes occurred between the two divisions regarding the appropriate placement of various programming. SPE made its case for why education initiatives should be managed through that division. The Directorate listed as two of its foundational objectives “To encourage the truthful and accurate introduction of science and scientists as concepts to all our young people;” and “To insure that courses of study in the various sciences at all levels are the most stimulating and instructive possible.” The objectives were not arbitrarily chosen, it was made clear, but rather came about through “considerations by the Program's staff, of means appropriate to a Federal Agency.”⁹⁹ In fulfilling these

⁹⁴ Ibid., 1.

⁹⁵ Ibid.

⁹⁶ The CEEB, for instance, established a Commission on Mathematics to investigate the needs of the nation's students. It issued a report with recommendations for a college preparatory curriculum and developed a sample twelfth grade textbook. David Klein, “A Brief History of American K-12 Mathematics Education in the 20th Century,” in *Mathematical Cognition*, edited by James M. Royer, (Greenwich, CT: Information Age Publishing, 2003), 184.

⁹⁷ William J. Hoff to Alan T. Waterman, “Authority for 1957 Program ‘Education in the Sciences,’” memorandum, January 13, 1956, 1. Division of Scientific Personnel and Education, Research Education in the Sciences; Box 19; Records of the National Science Foundation, Office of the Director, General Records, 1949-63, RG 307; NACP.

⁹⁸ Annual Report of the Division of Scientific Personnel and Education, 1956, 36. Annual Reports of Offices and Divisions – 1956; Box 1; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

⁹⁹ Ibid., 8-9.

objectives, the SPE Division aimed to advise on and assist in the development of national policies in education, primarily through its constituent unit, the Education in the Sciences Program.¹⁰⁰

The Education in the Sciences Program did not simply pay lip service to a problem that was gaining national attention. In fiscal year 1956 it was allocated \$1,421,955, or roughly a third of the overall SPE budget.¹⁰¹ By the end of 1956, too, plans were underway to hire three new Program Directors, due in large part to the “several-fold increase in funding level in the Education in the Sciences Area for FY 1957.”¹⁰² SPE was clearly positioning itself to wrest control over education programs that were, to that point, spread throughout various divisions throughout the NSF. In its 1956 Annual Report, the Division made a direct plea to this end:

It is difficult for the staff of this Division to see how the Foundation can develop a unified and consistent program for education in the sciences if responsibility for it is scattered through three major divisions. Policies respecting such sensitive subjects as Federal control of education, intervention, level of support and cases of support appropriate to a Federal agency established in one Division or Program are likely, as we know from experience, to be violated in others. In order to insure uniform treatment of educational proposals it would be well for the Foundation to reconsider its present policy relating to the jurisdiction of educational proposals.¹⁰³

Slowly, the NSF was entering the American precollege classroom. It then was becoming clear that these “increasing responsibilities of the Foundation in the area of science education have led to the need for additional clarification of organizational responsibility.”¹⁰⁴ Waterman offered exactly this clarification, resting most responsibility for education in the sciences to the SPE Division, though projects or proposals that demanded significant funding in *both* research and education were to be processed by the appropriate disciplinary division (either MPE or the Division of Biological and Medical Sciences) should research accomplishment be the predominant aim of the project.¹⁰⁵ To provide an example, a chart was distributed to help describe the jurisdiction of various educational things. SPE held primary responsibility for, among other things, “[a]ctivities directed toward improvement of science curriculum, high school and college (e.g., conferences on curriculum, preparation of syllabi, etc.).”¹⁰⁶

¹⁰⁰ Ibid., 2.

¹⁰¹ Ibid., 46.

¹⁰² Ibid., 51.

¹⁰³ Ibid., 45.

¹⁰⁴ Alan T. Waterman to Assistant Directors for Biological and Medical Sciences; Mathematical, Physical and Engineering Sciences; Scientific Personnel and Education, “Responsibility for Programs Involving Education in the Sciences,” memorandum, April 26, 1957, 1. Division of Scientific Personnel and Education; Box 39; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

¹⁰⁵ Ibid.

¹⁰⁶ “Administration of Activities of the National Science Foundation that Bear on Education in the Sciences,” undated, 2-3. Division of Scientific Personnel and Education; Box 39; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

Perhaps unsurprisingly, this organizational structure did not appease all members, particularly those in the MPE Division, which had earlier and consistently vocalized that Division's (including the mathematicians') interest in precollege education. Following Waterman's announcement, the MPE Division wrote a memo to him complaining of some vagueness of the chart he drew up on where responsibilities for education lay. One of these areas listed was in the development of curricula: "One of the serious difficulties of many modern science curricula is the failure to be research-oriented, especially in giving an appreciation of both modern research and its techniques."¹⁰⁷ Ultimately this concern would be addressed with the SPE Division support of discipline-centered curriculum reform projects—projects that allowed the mathematics education community autonomy in purpose while working within the NSF funding structure.

Though the NSF supported projects in course content beginning in 1954, these early efforts were "largely exploratory in nature and designed to help identify the problems and to find ways of attacking them. As early studies proved to be productive, the dimensions of the problem began to appear."¹⁰⁸ By 1956 "Course Curriculum Improvement" (CCI) as a program element had appeared, but the formal adoption of the CCI program did not occur until 1957, in part due to supportive legislation that began to emerge from Washington.¹⁰⁹ Early in the year Waterman was informed of Congressional bills that might be of importance to the Hearings before the Senate Labor and Public Welfare Committee. One of the bills listed was the Administrative Education Bill—which would later be passed as the Educational Development Act of 1958, or S. 3163, Smith (R-NJ)—that included an authorization of appropriations to states for aptitude testing among K-12 students, as well as the development of programs for expansion or improvement of studies and demonstrations designed to modernize science or mathematics curricula, instructional materials and classroom or laboratory in public elementary or secondary schools¹¹⁰ The first provision would come to be important in the NSF's work in data collection and assessment that built throughout the latter half of the twentieth century; the second would help organize programs of allotting federal funds to directly expand or improve curricula. Though this funding would go directly to states and not through the NSF as a clearinghouse (the Foundation had separate Congressional appropriations), such legislation served as a model for the top-down approach to education reform that allowed entry to the classroom to the federal government while at the same time maintaining local autonomy.

By mid-1957—beginning even before the launch of Sputnik—the combination of increasing public concern over the perceived state of US math and science education in

¹⁰⁷ Acting Assistant Director of MPE to the NSF Director, "Responsibility for Programs Involving Education in the Sciences," memorandum, April 8, 1957, 2a. Division of Scientific Personnel and Education; Box 39; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

¹⁰⁸ Howard F. Foncannon and William A. Jaracz, "Checkpoint, A Review for a Look Ahead," *Scientific Education Planning Memorandum No 1*, January 1960, 29. Divisional Committee for SPE- 1960 and back; Box 52; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP..

¹⁰⁹ "Brief Summary of the National Science Board's Role in Pre-College Curriculum Development and Implementation Program," May 2, 1975, 1. Attachment to Anderson to Members of the National Science Board, "Course Content Improvement – Material and Instruction Development," May 5, 1975. Course Content Improvement Program (1965-1977) (2); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

¹¹⁰ United States Senate, 85th Congress, 2d. Session, S. 3163, January 28, 1957, 16-17. Hearing before the Subcommittee on Education Senate Labor and Public Welfare Com. March 6, 1958; Box 28; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

the schools and supportive legislation from Washington helped usher course content improvement programs to the forefront of NSF education initiatives. At this time several groups of scientists “arose spontaneously” to undertake curricular reform, “based on fundamental principles and reflecting contemporary knowledge and theories.” The mathematics education groups, of course, did not arise spontaneously, but instead were drawn from a rich history of coordination on education reform concerns. Set against an increasingly supportive legislative and fiscal backdrop, the mathematics education community strengthened in the pre-Sputnik years, and its disciplinary consensus about the importance of curricular reform helped propel the mathematics curricula reform projects in the new math era as some of the most prominent.

Post-Sputnik Mathematics Education and the NSF

By the launch of Sputnik, the mathematics education community was further strengthened in unofficial membership and supported by new financial and legislative structures. Though the 1954 NCTM *Yearbook* on emerging practices in education did not indicate much in the way of revolutionary change happening—at the time—in reform, the yearbook does demonstrate the collective and widespread interest in reform shared among the community.¹¹¹ It also demonstrates the wide-ranging attempts undertaken by various members of the community to address issues of content and pedagogy—a variety of approaches aimed at a common goal. Yet these efforts received little attention outside of the community until the U.S.S.R. launched Sputnik, the first space satellite, in October 1957.

Sputnik dramatically changed the pace of curriculum reform efforts in mathematics and science. President Eisenhower responded to the Russian satellite by announcing that the United States would meet the challenge, and one way in which we were to do so was to outmatch the Soviets in “specialized education and research.”¹¹² Immediately thereafter Senate and House hearings on federal funding of education were scheduled. Eisenhower stuck to his promise. By the end of the year, a White House press release was issued listing the NSF’s activities in science education with the note that appropriations for these programs amounted to \$14.5 million of the total Agency budget of \$40 million. This would be drastically increased; it was announced in this press release that Eisenhower would request a substantial increase to the NSF appropriation for fiscal year 1959, with “more than half, or about \$79 million,” allotted specifically for science education activities.¹¹³ Earlier, in November of 1957, Waterman had “expressed pleasure over the action and confidence in the cooperative and complementary manner in which the White House office and the Foundation could work together;” no doubt this announcement only augmented this feeling.¹¹⁴

¹¹¹ Osborne and Crosswhite, “Reform, Revolution, and Reaction,” 258.

¹¹² Glenda Lappan and Jeffrey J. Wanko, “The Changing Roles and Priorities of the Federal Government in Mathematics Education in the United States,” *A History of School Mathematics*, vol. 2, edited by George Stanic and Jeremy Kilpatrick. (Reston VA: National Council of Teachers of Mathematics, 2003), 903.

¹¹³ James C. Harty, Press Release, The White House. December 30, 1957. Division of Scientific Personnel and Education; Box 39; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

¹¹⁴ Minutes of the 24th Meeting of the Divisional Committee for SPE, November 14-15, 1957, 2. Divisional Committee for SPE- 1960 and back; Box 52; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

Prior to the White House press release announcing the intention to increase the NSF budget, Harry Kelly took the opportunity to reexamine the fiscal year 1959 budget “in the light of current events – i.e., Russia’s launching of an earth satellite, etc.,” as well as “increased Congressional interest in education in the sciences as well as greater activity in the Federal Government itself.”¹¹⁵ Under the assumption that such increased Congressional interest might directly translate to increased Congressional funding, Kelly determined that new programs might be realistically considered. Kelly wrote to Waterman explaining that there were a number of projects that SPE believed “would help improve scientific and technical education in the United States” that were not included in the presentation on the fiscal year 1959 budget because of “uncertainties about economic limitations.” Attached to Kelly’s letter is a list of these budget-contingent projects—what he calls “C” budget projects.¹¹⁶ One such budget item is one million dollars requested for secondary school course content improvement, with an additional proposal for \$400,000 each to be applied to work in elementary and junior high curricula.¹¹⁷ Following this item is a list of proposed discipline-specific projects; mathematics is listed first, with a proposal for the establishment of twenty regional centers, estimated to reach nearly 28,000 K-12 teachers, at \$40,000 per center for a total cost of \$800,000.¹¹⁸ Though this project was admittedly generous, and an innovative approach to mathematics education reform, Kelly saw the need for more focused reform of the curriculum. In December 1957 he acted, calling Minna Rees, distinguished mathematician and Dean of Faculty at Hunter College, asking if she “would be interested in the job of gathering together a team of top mathematicians to work on the problem of developing curricula textbooks, models, etc., on mathematics.” Though Rees responded that she was not sure she could take on another responsibility, she promised to give Kelly an answer after a January 1958 meeting with fellow mathematicians.¹¹⁹

Just a few days before Rees met with the mathematicians, the American Mathematical Society (AMS) and the National Academy of Sciences – National Research Council (NAS – NRC) convened about forty leading mathematicians in Chicago to discuss inadequacies in and suggest solutions for improving school mathematics. Following this meeting, Rees chaired a meeting at the Massachusetts Institute of Technology—chosen for its proximity to the work being done at PSSC—to think about school mathematics improvement. Recommendations from both conferences led to the establishment of the School Mathematics Study Group (MSG), which became the team of top mathematicians charged with improving curricular materials that Kelly asked for. Chaired by Edward G. Begle of Yale University, MSG set to work in the summer of 1958 under a grant from the NSF.¹²⁰

¹¹⁵ Ibid.

¹¹⁶ Harry C. Kelly to Dr. Alan Waterman, memorandum, November 14, 1957. Division of Scientific Personnel and Education; Box 39; Records of the National Science Foundation, Office of the Director General Records 1949-63, Box 39, RG 307; NACP.

¹¹⁷ Division of Scientific Personnel and Education, “‘C’ Budget Programs,” November 9, 1957, 12. Division of Scientific Personnel and Education; Box 39; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

¹¹⁸ Ibid., 15.

¹¹⁹ Harry C. Kelly, Diary Note, “Telephone conversation between Dr. Minna Rees, Hunter College, New York, and Dr. Kelly,” December 18, 1957. Division of Scientific Personnel and Education; Box 39; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

¹²⁰ Ibid.

Despite such forward momentum, the legislative structure allowing such federal efforts was not yet in place. Ultimately it was determined that a defense education bill that the post-Sputnik rhetoric of competition and national security would be the most successful choice in legislating a path for federal involvement in classroom curriculum.¹²¹ Though the National Defense Education Act did face heavy opposition—particularly from Conservatives who favored less federal intervention—the bill passed through both houses of Congress in August 1958.¹²² NDEA differed from past legislation in that it specifically allotted funding for precollege education, an area where the federal government had not previously tread. It awarded funds to states for improving science and mathematics teaching (as well as foreign language instruction) and, importantly, NDEA also allotted funding for testing student achievement.¹²³

Eisenhower was skeptical of NDEA, but it received so much press that he had no choice but to sign the \$1.6 billion, four-year defense education bill. At the same time, too, Eisenhower increased four-fold the appropriations for the NSF's efforts in science and math education. He said that he approved of the objective "to inspire the people who have normally been responsible for [the] educational process to do better," but he worried that "[i]f you try to take it in such a sweeping way that the whole country is looking merely to the Federal Government to do this now for the coming years, I think we have lost a very great and vital feature of our whole free system."¹²⁴ Eisenhower was not alone in this sentiment; in an appendix to a report by the Labor and Public Welfare Committee, Republican Senator Barry Goldwater summarized the attitude of those opposed to federal aid to education, comparing such aid to "an old Arabian proverb: If the camel once gets his nose into the tent, his body will soon follow. If adopted, the legislation will mark the inception of aid, supervision, and ultimately control of education in this country by Federal authorities."¹²⁵ With the passage of the NDEA, however, the proverbial camel had entered the tent: federal involvement in the American precollege classroom had become a reality with one bill, and the rest of the camel—the full legislative and regulatory force of the federal government—was sure to follow. Indeed, the NDEA did just this, pushing open "the door of federal aid to education sufficiently so as to make the final breakthrough (which came seven years later with the enactment of the Elementary and Secondary Education Act) much easier."¹²⁶

Despite this metaphor, the NDEA was built on a foundation of limiting the federal role in the U.S. classroom. During a July of 1958 meeting of the President's Science Advisory Committee (PSAC), a discussion was held about the proper ways to establish educational standards for the country, yet the members were reminded that no federal program "requires or implies any enforced local adherence to educational standards; it is a purely voluntary procedure to which local groups could conform or not, as they choose." PSAC recommended that government funds would best be used to support contracted groups of teachers, scientists, and other experts that would "work out the

¹²¹ Lappan and Wanko, "The Changing Roles and Priorities of the Federal Government," 905.

¹²² Brian J. Glenn and Steven M. Teles, *Conservatism and American political development*, (Oxford: University Press, 2009), 105.

¹²³ *Ibid.*, 106.

¹²⁴ Gareth Davies, *See Government Grow: education politics from Johnson to Reagan*, (Lawrence, KS: University Press of Kansas, 2007), 16.

¹²⁵ Glenn and Teles, *Conservatism and American political development*, 105.

¹²⁶ Lappan and Wanko, "The Changing Roles and Priorities of the Federal Government," 905.

complete syllabus and curriculum for the entire education up through high school and provide or identify the text-books, exams, and other learning aids.” The finished product, then, would be available on a voluntary basis, yet it was thought likely that “local school systems would strive to use the program thus established. There would certainly be parental and other pressure for them to do so.” In such a system, the government would develop a curricular framework while not infringing on local autonomy, as state and local groups would be responsible for the adoption and dissemination of materials and the implementation of standards.¹²⁷

PSAC rubber-stamped the existing, preliminary efforts sponsored by the NSF as “excellent” and “most encouraging” models of reform, though the programs were said to need “very rapid and substantial expansion.”¹²⁸ Importantly, PSAC recommended that the improvement of course content was the most important component of education reform: “Subject matter should have priority over all other considerations, and attention should first be concentrated here.”¹²⁹ Central to this was the importance of generating—with regularity—new curricular materials developed, in part, by top scientists and mathematicians.¹³⁰ The solution to the problem, then, was seen to be setting up and adequately financing research and development groups “that constantly work on the content of the important courses and the most effective methods of teaching each part. These organizations would publish textbooks, teachers’ manuals, teaching aids, films, etc.”¹³¹

The first step was in the financing, and rapidly expanding budgets at the NSF made the funding of such groups possible. Over the course of 1952-1960, 7.7 percent of the Education in the Sciences funds was dedicated to course content improvement, totaling around \$13.5 million. The annual budgetary breakdown is offered in Table 3.¹³²

NSF Funds for Course Content Improvement	
FY 1954	\$2,000
FY 1955	\$35,000
FY 1956	\$17,000
FY 1957	\$630,000
FY 1958	\$835,000
FY 1959	\$6.020 million
FY 1960	\$6 million

Table 3

¹²⁷ “Extract of Minutes – Discussion on Scientific and Engineering Education – President’s Science Advisory Committee – July 21, 1958,” undated, 2-3. President’s Science Advisory Committee – 1958 Education Panel; Box 37; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

¹²⁸ “Education for the Age of Science,” Statement by the PSAC May 1959, 15-16, 29. President’s Science Advisory Committee – 1958 Education Panel; Box 37; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

¹²⁹ *Ibid.*, 15.

¹³⁰ “Minutes of the Meeting – PSAC Panel on Education, July 20, 1958,” undated, 2. President’s Science Advisory Committee – 1958 Education Panel; Box 37; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

¹³¹ Chauncy to _____, memorandum, July 18, 1959, 3. President’s Science Advisory Committee – 1958 Education Panel; Box 37; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

¹³² Foncannon and Jaracz, “NSF Approaches to Problems in Science Education 1952-1960,” 5.

Certainly, there was a sharp uptake in funding following the post-Sputnik release of vast amounts of federal dollars for education in the sciences—perhaps most strikingly understood as a visual [Fig. 2].¹³³ Yet such sharp increases in funding could not be expected to be sustainable for the next decade—the question was where the NSF could take its CCI programming into the future and how the Foundation would fund it. By the end of the 1950s, then, the NSF produced a document that both reviewed the previous work in precollege education through the NSF and also took the opportunity to look ahead. This document, aptly titled “Checkpoint, A Review for a Look Ahead,” demonstrates the prominence of the mathematics education community in past NSF efforts, as well as its projected importance for the future. At the 1960 checkpoint, the

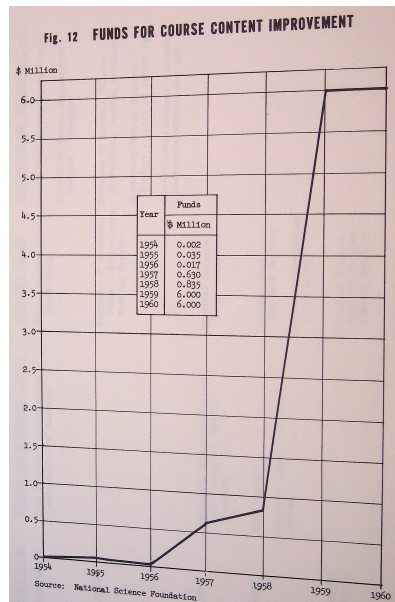


Figure 2

NSF had already begun to support three precollege education programs: SMSG for grades 9-12, SMSG for grades 1-8, and the Elementary School Mathematics Project at Stanford University. Biology was listed as the only other scientific discipline with that many supported projects; physics, chemistry, atmospheric sciences, and anthropology all had—at the time—only one secondary-level program supported by NSF.¹³⁴ In part, the preponderance of mathematics curriculum reform projects can be attributed to the widespread and coherent interest in reform among mathematicians—they were organized (at least conceptually) and able to create productive working groups and apply for NSF funding.

But the momentum was still building for the mathematics education community and for the Foundation’s course content improvement programs. The backdrop was right—historian Peter Dow describes this period as one where “Never before had school improvement been such a focus of national concern.”¹³⁵ Importantly, this focus was aimed in large part toward the NSF; the minutes of a May 1960 meeting of the SPE

¹³³ Ibid., 30.

¹³⁴ Ibid., 31-32.

¹³⁵ Lappan and Wanko, “The Changing Roles and Priorities of the Federal Government,” 909.

Division record that the group's general opinion held that attitudes about school math and science "had changed radically within recent years" and many institutions, national groups, and teachers had begun to accept NSF programs "as a permanent and natural part of our educational life today."¹³⁶

Just as the checkpoint highlighted the strengths of mathematics in past NAF work in education, shifting priorities within the Foundation solidified its continued importance in educational programming. By February 1960, the NSF began to formally recognize the need to expand programming into the elementary schools, though a number of concerns were laid out about the appropriate path for NSF involvement. These included a lack of consensus of how math and science might be integrated into the elementary curriculum, the proper role of the NSF in this area, and the incomplete evidence regarding effective means of strengthening education at this level. Yet alongside such concerns it was stated that "[t]here is a growing conviction that much needs to be done at the elementary level and done in such a way that it forms a logical continuum with education at the secondary and higher levels" and that subsequently there is a "growing pressure to have the Foundation move more forthrightly into the elementary area, this pressure appearing in the form of letters from scientists, teachers, principals, and other school administrators, and in the form of Congressional letters of inquiry." Existing programs in elementary education improvement, as well, were reported to have received some of the most favorable comments out of newer SPE programs.¹³⁷ Quickly, this "growing conviction" of the importance of curricular reform at the elementary level—paired with "growing pressure" placed on the NSF to spearhead such efforts—overshadowed any concerns about moving in this direction.

Mathematics projects played an important role as the NSF sought to extend curriculum improvement projects to the elementary level. First, mathematics was an obvious target for such reforms, as math is central to the entire K-12 curriculum—other sciences are less continuous in the elementary curriculum. This would, practically speaking, increase the prominence of mathematics programs in NSF-funded curriculum projects at the elementary level. Second, the attention given to educational psychology would render mathematics projects—with a tradition of working alongside such research—preferential treatment, as NSF recommendations clearly articulated an interest in such integration:

Course content studies at this level must give special attention to the learning capacities of children at successive levels, variations among individuals and other psychological problems; better use can be made of reasonably well-established knowledge but much remains to be learned; curriculum groups and highly competent experimental psychologists interested in basic processes of education can contribute in important measure to one another's work. Determining what can be taught at successive levels also requires experimental teaching, imaginative

¹³⁶ Minutes of the 34th Meeting of the Divisional Committee for SPE, May 6-7, 1960, 6. Divisional Committee for SPE-1960 and back; Box 52; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

¹³⁷ Bowen C. Dees to Associate Director (Educational and International Activities), "SPE Programming at the Elementary School Level," memorandum, February 25, 1960, 2-3. Division of SPE 1960 – general; Box 52; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

development of methods of presentation and utilization of all available learning resources.¹³⁸

Mathematics education projects had, of course, already addressed this issue and therefore subsequent funding requests would be looked upon favorably. But other aspects of the cohesion of the mathematics education community situated these programs at the forefront of elementary curriculum improvement projects. This is well demonstrated in a series of documents produced within the NSF highlighting plans for programs in this area that prioritize existing projects in mathematics as exemplary models. Four types of projects were listed for consideration for fiscal year 1960, the first of which was described as “feasibility, coordination and liaison projects.” Such projects would be aimed at compiling “reliable information on diverse current attempts to improve elementary and junior high school science should be available to all who wish to undertake studies. As projects develop, coordination and collaboration among them will become increasingly important.”¹³⁹ While such articulation encompasses all disciplines, the recommendation for fulfilling this goal focuses solely on mathematics, offering SMSG work as an example and encouraging the group to “continue to collect information and provide general guidance on types of course content studies needed, and may propose projects on its own.” A second type of project outlined for consideration was “Studies by major curriculum groups.” Here, too, the recommendation for fulfilling this goal is centered on mathematics projects, noting SMSG achievements and suggesting “continuation of support for continuation of the grade 7-8 project of the School Mathematics Study Group and a pilot project for grades 1-6.”¹⁴⁰

The use of mathematics in the above examples was not mere coincidence. It not only represented both the sophistication of the work in elementary mathematics education, but also the unique qualities of mathematics education that rendered it well-suited for the types of curriculum reform projects prioritized by the NSF:

The probable direction of future efforts at the elementary level will be in the area of mathematics rather than the sciences. The grade level at which different topics are introduced tends to vary considerable from one school to another, and in order to provide the flexibility required, the CCI material is frequently prepared in self-contained modules which can be assembled into the sequence desired. While attempts are being made at the junior high school level to weld the common elements of science into CCI material for general science courses, difficulty is being encountered in avoiding a result which is just a collection of little bits from different sciences.¹⁴¹

¹³⁸ Division of Scientific Personnel and Education, CCI Section, “Proposed Policy for Curriculum Studies, Grades 1-9,” 6. Division of SPE 1960 – general; Box 52; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

¹³⁹ NSF Division of SPE, CCI Section. “Course Content Improvement Studies on Mathematics and Science for Elementary and Junior High Schools”, position paper, 2. Division of SPE 1960 – general; Box 52; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

¹⁴⁰ Ibid., 3

¹⁴¹ Report of the Meeting of the Advisory Committee for MPS, October 6-7, 1966, 9. MPS Advisory Committee Minutes, 1966-1972; Box 39; Records of the National Science Foundation, NSF Agency Historians Files, RG 307; NACP.

Mathematics curriculum improvement projects, then, could produce stand-alone modules that could readily be strung together in various (though not infinite) sequences to provide unique curricula for various school systems. In the sciences, such materials would almost necessarily result in a disorganized curriculum comprised of a hodgepodge of scientific topics. In addition to this, however, is the important recognition that these efforts would be most important *at the elementary level*. Math was a constant in all grades in the K-12 curriculum, so a clear candidate for curriculum improvement projects at the elementary (and then secondary) level. As the 1960s ushered in more federal interest in improving elementary education, this brought the mathematics classroom to even greater prominence in education discussions.

A second criteria gaining traction as an important aspect of the NSF's CCI programs—assessment—also fit neatly with mathematics education projects, and arguably more so than those in the sciences. With a focus still primarily on the elementary grades, it was noted that “science is seldom treated as a course or courses separate from, say, English or history, yet here is the level at which the student is most open-minded and susceptible to good teaching or vulnerable to bad.”¹⁴² Math, on the other hand *was* ordinarily separated from English or history, making it more of an independent variable (relatively speaking) for study and—importantly—assessment and evaluation.

These two components, brewing already in the early years of 1960 when the NSF's involvement in course content improvement was just ramping up, would prove to be crucially important in shaping the important role of mathematics education reform in NSF programming through the next four decades of the Foundation's often tumultuous relationship with precollege education.

The New Math

Some of the most prominent of the NSF programs were those of the new math—or the collective term for the variety of curriculum improvement programs (most of which funded by the NSF) that were undertaken in the late 1950s and 1960s. The new math programs were prominent for a number of reasons. First, practically, the mathematics curricula spans all twelve years of precollege instruction, so students and parents had many opportunities to interact with new materials. Second, the proliferation of new math materials—and materials that borrowed from new math approaches even if not “technically” part of the new math era reforms—was widely recognized, even among those who did not use the materials in the classroom. And third, much of the content and method of many of the new math curriculum programs was radically different from the “traditional” curriculum, which ultimately proved to be both a boon and a curse to the longevity of these programs.

The history of the new math era is itself fairly well documented—an overview of the numerous individual projects would be redundant here. Yet what it rarely discussed is how the new math reform programs contributed to an overall sense of coherence in the mathematics education community during the reforms and how the new math era shaped the community's coherence in the decades following. The new math cannot be understood as a monolith movement—there was in fact no one thing as the new math (though the School Mathematics Study Group (MSG) project is popularly remembered

¹⁴² “Purpose, Scope and Nature of Activity,” 4.

as “the” new math). A retrospective view of the new math programs from 1975 reports, “selection of content and exclusion of other content is value-laden and there is by no means unanimity of opinion in professional mathematics or mathematics education as to selection or emphasis on particular content.”¹⁴³ Various programs, ideas, and materials that fell under the new math umbrella had a wide variety of content, many influences from psychology and learning theory, and a variety of pedagogical approaches. Yet the programs did draw from a common pool of themes that served to unify the community as one in the pursuit of common goals. These themes included, “new mathematical topics with a contemporary flavor, emphasis on structural concepts and logical reasoning processes of broad generality, cognitive and developmental theories of learning, and teaching that engaged students in an active search to discover mathematical principles and techniques.”¹⁴⁴ New math programs also all shared a common interest in logical explanation for content taught, a replacement for progressivist education, and a need for “expert” influence on the curriculum (in other words, input from the mathematics education community). Even as various programs worked independently, too, they collaborated with one another; one participant in the SMSG project remembered sharing materials with “competing” programs.¹⁴⁵

The new math era began with the University of Illinois Committee on School Mathematics (UICSM), which set the stage for subsequent efforts, even as SMSG is popularly remembered as the “face” of the new math programs. UICSM stressed that the goal of mathematics education was understanding and not simply the manipulation of symbols, as well as the importance of precise vocabulary and discovery learning.¹⁴⁶ In all of the programs, students were encouraged to develop a deeper understanding of mathematics concepts and structures to apply to specific problems, rather than rely on rote memorization. The new math stressed topics such as set theory, operations and place value in different base systems, and alternate algorithms for operations on fractions. Most programs also advocated a parallel presentation of geometry and arithmetic in the elementary grades, and an introduction to probability, statistics, and calculus for all students.¹⁴⁷ These projects all ultimately aimed to “introduce a formal understanding of mathematical principles and concepts from the early grades onward,” a method referred to as the “spiral” curriculum.¹⁴⁸ To tie the curriculum together throughout all of the grades, topics such as measurement, graphical representation, and logical deductions were consciously utilized as recurrent themes. Ultimately, the new math intended to arm students with “familiarity with mathematics” that would be adaptable to all sorts of applications, as students would not simply be memorizing processes. Good intentions aside, this approach drew much criticism from people who doubted the real-world

¹⁴³ National Science Foundation. *Panel Evaluation of 19 Pre-College Curriculum Development Projects*. (Washington DC: NSF, 1975), 51. As quoted in Robert B. Davis, “Changing School Mathematics,” in *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick, (Reston VA: National Council of Teachers of Mathematics, 2003), 625.

¹⁴⁴ Fey and Graeber, “From the New Math to the *Agenda for Action*,” 526-527.

¹⁴⁵ James Wilson, interview with Dave L. Roberts, (University of Georgia, May 24, 1999), 39. National Council of Teachers of Mathematics Oral History Project. Archives of the American Mathematical Association, University of Texas at Austin.

¹⁴⁶ John Woodward, “Mathematics Education in the United States: Past to Present,” *Journal of Learning Disabilities* 37:1 (Jan/Feb 2004): 17.

¹⁴⁷ Osborne and Crosswhite, “Reform, Revolution, and Reaction,” 292.

¹⁴⁸ Woodward, “Mathematics Education in the United States: Past to Present,” 17.

applicability of this type of math. For example, in the new math curriculum, $7a + 2a = 9a$ not because of the fact that 7 apples plus 2 apples amounts to 9 apples, but because of the distributive property of multiplication over division.¹⁴⁹ Such criticisms ultimately led to a reevaluation of the importance of pedagogy.

Some of the new math programs—most notably the SMSG—fell within a R-D-D model, or research-development-dissemination, with the goal of the project being product-oriented with the production of curricular materials. In such projects, mathematicians specify content, then specialists develop this content into curricular materials, and finally these are marketed and distributed. In such a model “[t]he translation from concept to practice makes no special pedagogical demands since in this approach new content is seen as the goal of reform.”¹⁵⁰ However, other new math projects relied heavily on influences from educational psychology—beginning with UICSM, in fact—and such attention to pedagogical and theoretical issues came to bear more importance to the mathematics education community (and even to the SMSG project) as the new math era progressed and ultimately declined. These influences, as well as the importance attention to data collection and evaluation in the new math programs, are discussed in the subsequent two sections.

Educational Psychology

In 1950, *The Mathematics Teacher* began a new department, “Research in Mathematics Education,” that was aimed to acquaint readers with the explosion of new research in this area.¹⁵¹ By that time it was clear that there was a lot of research, but there needed to be coordination between mathematics educators and the psychologists. There was a problem, however, getting the two groups to talk together—they needed more mathematicians who understood psychology and vice versa. Though conferences were organized to bring together the two groups, the ideas exchanged were “were not always productive of immediately useful results, but they did much to make each group aware of the contributions that could come from the other discipline.”¹⁵² As the curriculum projects at the NSF took off, attention to this type of research became more commonplace—particularly in mathematics.

In 1959, a conference funded (in part) by the NSF was convened in Woods Hole, Massachusetts, aimed at achieving the goals of creating exactly such “challenging, stimulating, and exciting” curricular materials. Specifically, the goal of the short meeting was to analyze curriculum innovations in terms of new psychological research. Though the conference ostensibly approached all areas of precollege math and science, the mathematics curriculum was determined to be particular applicable and attendees paid particular attention to the question of how early general topics of a subject matter in mathematics could be introduced.¹⁵³ The discussion that unfolded at this New England

¹⁴⁹ Osborne and Crosswhite, “Reform, Revolution, and Reaction,” 284.

¹⁵⁰ Geoffrey Howson, Christine Keitel, and Jeremy Kilpatrick, *Curriculum Development in Mathematics*, (Cambridge: Cambridge University Press, 1981), 127.

¹⁵¹ Jeremy Kilpatrick, “A History of Research in Mathematics Education,” in *Handbook of Research on Mathematics Teaching and Learning*, edited by Douglas A. Grouws, (New York: MacMillan, 1992), 23.

¹⁵² M. Vere DeVault and J. Fred Weaver, “Designing a Contemporary Elementary School Program: 1952-Present,” in *The National Council of Teachers of Mathematics. A History of Mathematics Education in the United States and Canada: The Thirty-Second Yearbook*. Washington, DC: National Council of Teachers of Mathematics, 1970, 145.

¹⁵³ Joel H. Spring, *The Sorting Machine Revisited: national educational policy since 1945*, (New York: Longman, 1989), 87-88.

conference came to color the materials developed through SMSG and other NSF-sponsored projects aimed at reforming the precollege mathematics curriculum, and attention to (and involvement in) this research proliferated during the new math era.

The attention within the mathematics education community to new studies in psychology and educational research was recognized more widely by the NSF. In Waterman's delivery of the "Status Report of the Division of Scientific Personnel and Education" to the NSB, a number of curriculum improvement projects were listed, but notably none but the mathematics projects included any mention of collaboration with psychologists or learning theorists. This would prove to be an important distinction, as the SPE Division increasingly recognized that one of the contributing reasons for the poor state of math and science education was "inadequate understanding and application of knowledge of the psychology of learning and teaching science and mathematics."¹⁵⁴ In the ensuing years, mathematics education reformers would build upon a historical tradition of partnering with learning theorists and psychologists, with programs in classroom educational practices growing alongside research in cognitive science to address issues of pedagogy and student learning with greater frequency.

During the 1950s and 1960s, most educational psychologists emphasized the importance of student exploration and discovery through developmentally appropriate activities, a departure from earlier reliance on Thorndike and B. F. Skinner, which led to "an atomization of knowledge, in which teachers controlled each step in the learning process."¹⁵⁵ The new math programs, as described above, emphasized instead student-directed learning and deeper understanding of mathematics; new theories in educational psychology were sought to both support that position and inform curriculum development. Yet there was no consensus on the "best" theory to use, and consequently various new math projects used one or another theory. This was not seen as an issue of much concern among the mathematics education community, however:

That these theories [of learning] conflict at a number of points should not concern us too much. If the application of one of the conflicting theories proves more useful for our purpose in a given situation, and application of another theory in another, we shall use each as it fits the occasion. Until psychology develops into a more significantly unified, scientific theory we must do this.¹⁵⁶

Just as each curriculum program pursued its goals with independent aims, so did each project rely on educational psychology, with all major theories of learning "borrowed" in various contexts. In general, the three most influential theorists in mathematics curriculum reform were Robert Gagné, Jean Piaget, and Jerome Bruner.

¹⁵⁴ NSF Division of SPE, CCI Section, "Course Content Improvement Studies on Mathematics and Science for Elementary and Junior High Schools," position paper, 1. Division of SPE 1960 – general; Box 52; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

¹⁵⁵ Woodward, "Mathematics Education in the United States: Past to Present," 17.

¹⁵⁶ Howard F. Fehr, "Theories of Learning Related to the Field of Mathematics," in *The Learning of Mathematics: Its Theory and Practice*, edited by Howard F. Fehr, 1-41, (Washington DC: National Council of Teachers of Mathematics, 1953), 8. As quoted in Jeremy Kilpatrick, "A History of Research in Mathematics Education," in *Handbook of Research on Mathematics Teaching and Learning*, edited by Douglas A. Grouws, (New York: MacMillan, 1992), 23.

Educational psychologists Robert Gagné represented the behaviorist school of learning theory, and was known for his “conditions of learning.” Gagné’s theory—most notably used in the University of Maryland Mathematics Project—argued that knowledge is organized hierarchically, meaning that subordinate concepts must be learned before principles of higher order.¹⁵⁷ Gagné espoused task analysis, which encouraged that search for the organization of content along hierarchical lines. Basically, each concept or skill to be taught in the classroom was to be broken down into smaller and smaller steps for the student to complete in order, ultimately attaining full understanding of the concept.¹⁵⁸ An example of this can be found in an organizational chart produced by Gagné [Fig 3].¹⁵⁹

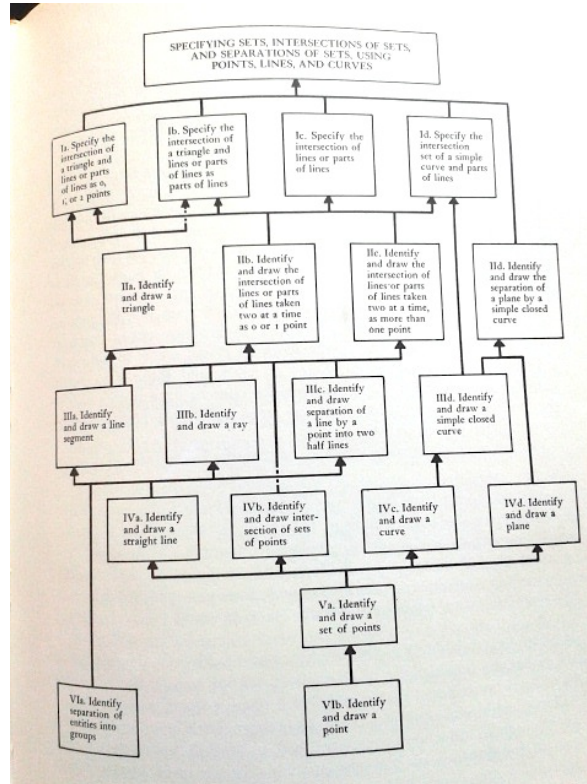


Figure 3

Behaviorist approaches to curriculum reform emphasized observable student performance and specific objectives, ultimately creating focused curricular materials that stressed practicality of use. Critics argued that this approach tended to create materials that compartmentalized education and made it a passive experience for the student.¹⁶⁰ Nevertheless, the emphasis on outcomes objectivized as observable changes in behavior was attractive to many in the mathematics education community who prioritized

¹⁵⁷ Philip S. Jones and Arthur F. Coxford, Jr., “Reform, ‘Revolution,’ Reaction: 1945-Present,” in *The National Council of Teachers of Mathematics. A History of Mathematics Education in the United States and Canada: The Thirty-Second Yearbook*. Washington, DC: National Council of Teachers of Mathematics, 1970, 84.

¹⁵⁸ DeVault and Weaver, “Designing a Contemporary Elementary School Program,” 140.

¹⁵⁹ *Ibid.*, 141.

¹⁶⁰ Howson, Keitel, and Kilpatrick, *Curriculum Development in Mathematics*, 151.

evaluative techniques, as the objective-driven behaviorist approach went hand in hand with measurability and assessment.¹⁶¹

The theories of developmental psychologist Jean Piaget offered a much different model for use by the mathematics education community. Though Piaget's work was not embraced by the mathematics education community until it was widely translated in the early 1960s, his theories of cognitive development were immediately "very popular... People were trying to connect that to mathematics education, and so we [in the mathematics education community] spent a fair amount of time reading Piaget's work and discussing [it]."¹⁶² Piaget represented the constructivism school of learning theory, arguing that children learn best through interaction and experience. Specifically important to mathematics education, Piaget's theory maintained that the learning built upon simpler operations and structures to "scaffold" a deeper knowledge. It also highlighted the difference between asking if the student was giving the correct answer and asking how the student was thinking about the problem, an issue that would increase in importance in the later years of cognitive science research on student learning.¹⁶³ Piagetian ideas about cognitive development of young children led to pedagogical reforms that emphasized the importance of hands-on, concrete activities and materials in teaching mathematical ideas, or "discovery" learning. This pedagogical technique adapted from behaviorism was attractive to the mathematics education community not just for its emphasis on the underlying structure of knowledge and the reliance on operations, but also because it fit well with the goals of professional mathematicians in terms of training students in the skills of exploratory investigation that often characterize the job of the mathematician.¹⁶⁴

Psychologist Jerome Bruner, representing the structuralist school of learning theory, reinterpreted Piaget's theories to develop a more complete picture of how learning theory could be practically employed in the classroom. Bruner espoused discovery learning and argued that any topic could be taught at any level, or, in his words, "any subject can be taught effectively in some intellectually honest form to any child at any stage of development."¹⁶⁵ He stressed the themes of structure in teaching, understanding of the student, readiness for learning, the nature of intuition, and the desire to learn.¹⁶⁶ Bruner advocated discovery learning, and stressed the pedagogical utility of exploring contrasts, developing hypotheses, and playing structured games, though he allowed that this process would be too time consuming in the traditional classroom for a discipline like mathematics.¹⁶⁷ What was particularly attractive to the mathematics education community about Bruner's theory, however, was his argument that cognitive structures are combinations of acquired concepts and thinking abilities, and furthermore that these structures are additive. Bruner described this structure as being akin to science itself, with simple facts and principles—content—building additively to uncover

¹⁶¹ Fey and Graeber, "From the New Math to the *Agenda for Action*," 540.

¹⁶² Jeremy Kilpatrick, oral history, 11-12.

¹⁶³ Robert B. Davis, "Changing School Mathematics," in *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick, (Reston VA: National Council of Teachers of Mathematics, 2003), 624.

¹⁶⁴ Fey and Graeber, "From the New Math to the *Agenda for Action*," in *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick, (Reston VA: National Council of Teachers of Mathematics, 2003), 526.

¹⁶⁵ Jerome Bruner. As quoted in Fey and Graeber, "From the New Math to the *Agenda for Action*," 525.

¹⁶⁶ Jones and Coxford, Jr., "Reform, 'Revolution,' Reaction: 1945-Present," 84-85.

¹⁶⁷ Woodward, "Mathematics Education in the United States: Past to Present," 18.

underlying theories and principles—or a way of thinking in science.¹⁶⁸ What this theory offered was a way to conceptually address both course content and pedagogy in a unified manner by stressing the interdependency of content and structure.¹⁶⁹ As interest grew in pedagogical methods, Bruner's theory gained particular traction.

Evaluation and Assessment

Growing alongside the increasing interest in educational psychology in the reform of curriculum was the interest in evaluation and assessment, both of student learning and particular program efficacy. These two interests were in fact interdependent, as more sophisticated research in educational psychology led many to recognize that evaluative methods were insufficient and not taking the multiple variables in the educational process into account. In November 1962, a two-day conference—convened to help advise the Panel on Educational Research and Development, a joint advisory group to the President's Science Adviser, the Director of NSF, and the US Commissioner of Education—was organized to begin to address these questions. The principal conclusion reached was that there is a need to develop a "theory of instruction." This theory was defined as dealing with the independent variables that affect teaching, such as children's home life or the organization of curricula. It was hoped that developing such a theory would "serve to bring into a more fruitful relationship, on the one hand, academic psychologists interested in child development and, on the other hand, teachers and other people directly concerned with that goes on in the schools."¹⁷⁰ The task of drawing up a treatise on this theory was placed on psychologists interested in cognitive development, personality development, and other aspects of human development.

Though this conference was aimed at all disciplines, the research maturity of mathematics curriculum projects was altogether clear. During the first day of the conference, participants reported on their research in child development, focusing on ways this research might serve to make instruction in the classrooms more effective. A report of the day's discussion mentioned only the presentations about "experimental work in teaching mathematics and...experimental work bearing on reading instruction," leaving all other disciplines unmentioned.¹⁷¹ This could, of course, be merely a coincidence—the personal preference of the author of the report. More telling, then, is the decision made at the end of the conference to have a study group convene in June to continue the discussion on child development. The location, Harvard University, was chosen because it would "afford the participants the opportunity to talk to many people in relevant pursuits expected to be near by, including a group of mathematicians working on a new mathematical curriculum for elementary school."¹⁷²

This conference grew out of an evolving understanding that curriculum improvement projects could not be expected to continue without evaluation of their

¹⁶⁸ Howson, Keitel, and Kilpatrick, *Curriculum Development in Mathematics*, 100-101.

¹⁶⁹ *Ibid.*, 152.

¹⁷⁰ Joseph Turner to Dr. Francis Keppel, et. al, "Report of two-day conference, November 10 and 11, at the Palmer House in Chicago, to explore in a general way the steps necessary to advance, and put to use, our knowledge of how children learn," memorandum, December 21, 1962, 1-2. PSAC – Panel on Educational Research and Development – to June 1963; Box 77; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

¹⁷¹ *Ibid.*, 3.

¹⁷² *Ibid.*

efficacy in the classroom. In 1961, when considering the question of future support of programs, Waterman said that:

The problem of looking ahead is made more difficult by the lack of a measure of need for the education programs of the Foundation and by uncertainties as to the extent and impact of general aid programs. It can be assumed, however, that there is a continuing requirement for special support of science education over the next few years and that the need is greater than the current programs of the Foundation provide for.¹⁷³

It was thus recommended that the Foundation should expand its support of science education, but at the same time develop better means of evaluation. With this statement, then, the near-official stance of the Foundation was that it acknowledged that no mechanisms for evaluation of program efficacy were in place but these programs should nonetheless continue to be supported based on a mere assumption that they were working. This was of course not sustainable, particularly as it was understood that “the approval of future requests for funds will depend increasingly upon evidence of satisfactory accomplishments by the programs in terms of their acceptance and practical applications of the results within the schools.”¹⁷⁴ Nevertheless, general NSF requirements for such evaluation were slow to develop. Only in 1964 were evaluation practices mentioned as desired characteristics for *new* NSF projects in a report outlining plans for the CCI program; these are listed below:¹⁷⁵

- a. Emphasis on scientific processes and attitudes rather than on results alone; hence, special attention to laboratory and field study.
- b. Fundamental recasting (rather than simply revising) of content in light of modern developments.
- c. Experimental attitude toward education, with exploration of various ways of helping students learn science, including regular texts, other reading materials, special materials for teachers, new laboratory experiments and apparatus, films, programed [sic] materials, etc.
- d. Exploration of implications of new courses and approached for understanding learning processes, and the converse.

Later in this document, too, problems with the CCI program were listed, the very first of which being the lack of “evaluation of projects and of programs; impact and effect on the

¹⁷³ Summary of Director’s Review: National Science Foundation, June 13, 1961, 4-5. Budget – FY 1963; Box 1; Records of the National Science Foundation, Office of the Associate Director for International and Educational Programs (Kelly), Subject Files 1951-1962, RG 307; NACP.

¹⁷⁴ Waterman to Members of the Senior Staff, “Instructions for the Preparation of Program Plans and Budget Estimates, FY 1963,” memorandum, March 13, 1961, 10. Budget – FY 1963; Box 1; Records of the National Science Foundation, Office of the Associate Director for International and Educational Programs (Kelly), Subject Files 1951-1962, RG 307; NACP.

¹⁷⁵ “Principles, Procedures and Plans for the Course Content Improvement Program,” June 8, 1964, 2, in Excerpt from the Record of Discussion, 95th, NSB—June 18-19, 1964, Agenda Item 3: Report on NSF Course Content Improvement Program. Course Content Improvement Program (1965-1977) (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

whole educational process.”¹⁷⁶ By the following year, it was announced that the NSF planned to devote some funding for CCI programs to “highly experimental small projects which are, in effect, at the borderline between subject matter and the psychology of the learning process. (Example: At what grade level can the law of thermodynamics be taught effectively?)”¹⁷⁷ For such projects the criterion for support was specified as based on what might be learned and *not* on the production of instructional materials. By August 1968 such projects had become more commonplace; in the annual report of course content improvement activities during the 1968-1969 school year, one additional point was added to the list of “patterns followed by successful CCI grants” that was not included in earlier years’ reports: “projects whose findings in fundamental studies of the learning process can be expected to be useful to other study groups.”¹⁷⁸

In mathematics, however, curriculum improvement projects were already collecting evidence of project results and meeting the required characteristics outlined in the 1964 report. One NSF-funded project, led by Patrick Suppes at Stanford and known as the “Arithmetic Project,” used extensive student testing during the 1960-1961 school year to evaluate curricular materials for the first-grade level. Students were tested on the material to determine levels of learning, but a comparison was also drawn of general achievement in arithmetic between experimental classrooms—those using the Arithmetic Project’s materials—and matched control classes. Though initial results were significantly in favor of the experimental classroom, more extensive evaluation was undertaken in 1961-1962.¹⁷⁹ Within a few years, the began working on a concurrent research program, a Project in Computer-Based Instruction in Elementary Mathematics, in which computer-based instructional materials were developed for use in the classroom *and* for evaluative objectives: “to use the computer to gather data on pupil performance, to use the computer to provide for differences in individual pupil capability, rate of learning of topics and other factors, and to explore potentialities of computer-based instruction to get around problems of teacher competence in mathematics.”¹⁸⁰ Ultimately, Suppes oversaw a six-year longitudinal study of one class of students who used this computer-based instructional material in grades 1-6.¹⁸¹

¹⁷⁶ *Ibid.*, 4.

¹⁷⁷ “Future Implication,” in National Science Foundation Education Divisions, “Status Report on the Course Content Improvement Activities of the National Science Foundation,” March 1965, 45. NSB Commiss. on Precollege Education – Status Report on Course Content Improvement Act; Box 7; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

¹⁷⁸ Neville L. Bennington to Members of the National Science Board, “Course Content Improvement and Related Activities in the Division of Pre-College Education in Science, September 1968 through August 1969,” memorandum, August 1, 1968, 1, in National Science Foundation Division of Pre-College Education in Science, “The Course Content Improvement Program: September 1968 – August 1969.” NSB Commission on Precollege Education – Course Improvement Program (Sept. 1968-Aug. 1969); Box 6; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

¹⁷⁹ Patrick Suppes, “Suppes Arithmetic Project,” in AAAS, “Report on Broad Improvement in Science Education,” *Science Education News*, undated, 7-8. Panel on Educational Research & Development (1962); Box 77; Records of the National Science Foundation, Office of the Director General Records 1949-63, RG 307; NACP.

¹⁸⁰ “Current Activities,” in National Science Foundation Education Divisions, “Status Report on the Course Content Improvement Activities of the National Science Foundation,” March 1965, 33. NSB Commiss. on Precollege Education – Status Report on Course Content Improvement Act; Box 7; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

¹⁸¹ Neville L. Bennington, Division Director Pre-College Education in Science to Dr. Leland J. Haworth, “Agenda Item: Presentation to the National Science Board of Course Content Improvement and Related Activities in the

Other NSF-funded projects in precollege mathematics education similarly focused on both learning theory and evaluation of materials. The Minnesota Mathematics and Science Teaching Project (MINNEMAST), a curriculum development project under the direction of Paul Rosenbloom at the University of Minnesota, was another prominent mathematics (and science) curriculum improvement project funded by the NSF. This project worked to “intimately associate” curriculum development with basic research on learning, with each subject taught “in the light of the best available research in that field.”¹⁸² Curricular materials were both assessed in test centers as well as distributed to experimental classrooms. These test centers were distributed nationally, and existed as part of the project to permit controlled evaluation of MINNEMAST curricular materials. Through these centers and in observation and experiment in classrooms, mathematicians and psychologists worked together to define the behavior taken to represent the output of the curriculum and developed techniques of measuring it.¹⁸³

The UICSM also heavily emphasized evaluative measures. Evaluation of UICSM materials was “carried out by specially trained personnel through classroom observation, feedback from teachers, and testing with teacher-constructed, project-designed, or standardized tests.” Of particular importance is this last point; at the time, standardized testing was not widespread in educational practice. Over time, such evaluative measures became fundamental to classroom assessment, with mathematics central to this shift. The UICSM project undertook a variety of sophisticated evaluative measures. One experimental approach was a “time-to-mastery” study that explored the properties of instructional time-to-mastery “as a dependent variable for instructional research and curriculum development. It is hoped through this study to develop techniques which will have useful applications in the evaluation and improvement of instructional materials.” At the same time, this study was aimed at providing measures of student aptitude and performance in terms of time needed to learn a task rather than in the more regularly used measure of test scores. UICSM also engaged in longer-term evaluative measures and undertook “a number of studies to provide a comprehensive report on students who have studied the UICSM high school sequence,” which was completed in 1962. The data collected included “both descriptive and statistical data on student characteristics of schools, training received by the students in UICSM materials and other experimental as well as traditional courses, outcome of instruction, and subsequent record in college and career.”¹⁸⁴

The most prominent of NSF-funded mathematics curriculum improvement projects, SMSG, engaged in groundbreaking curricula assessment from the early years of the program. Beginning in September 1962, approximately 110,000 students from forty

Division of Pre-College Education in Science for the period September 1968 through August 1969,” memorandum, August 19, 1968, 4. Course Content Improvement Program (1965-1977) (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

¹⁸² Leland B. Haworth to Members of the Executive Committee, NSB, “Proposed Course Content Improvement Project,” memorandum, May 21, 1965, 2. Course Content Improvement Program (1965-1977) (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

¹⁸³ Bennington to Haworth, August 19, 1968, 2-3. .

¹⁸⁴ Leland B. Haworth to Members of the National Science Board, “Proposed Course Content Improvement Project,” memorandum, November 2, 1965, 14. Course Content Improvement Program (1965-1977) (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

states and about 1500 schools became involved as participants in the ambitious National Longitudinal Study of Mathematical Ability (NLSMA).¹⁸⁵ NLSMA was funded by the NSF and administered through the SMSG program, tracking fourth, seventh, and tenth grade students in their mathematics classrooms. The study followed the progress of students taking conventional and newer types of mathematics curricula over five year periods and, in some cases, eight years.¹⁸⁶ These students were followed through their schooling, given frequent tests on mathematics achievement and aptitude tests, as well as selected psychological inventories to measure factors such as attitude and enjoyment.

The designers of NLSMA wanted to test both content and cognitive ability; the content aspect was relatively straightforward, but the cognitive aspect was more difficult—and unique in terms of evaluation. Traditional standardized tests in math were seen to be inadequate because they were seen to rely too heavily on memorization and could not measure the learner's ability to apply knowledge in new situations. The designers of the test sought a model that would measure not just achievement in number systems, geometry, and algebra, but also analysis, application, comprehension, and computation.¹⁸⁷ The tests were “designed to furnish data about the developmental aspects of achievement in mathematics as well as the psychological correlated of mathematical performance.”¹⁸⁸ This study was aimed at gathering necessary achievement data to help guide future cycles of curricular reform, as well as to learn more about the nature of mathematical abilities, which might guide tightly-controlled experiment in the future. Throughout the implementation of SMSG a number of evaluative instruments and techniques for assessing mathematics achievement were developed.¹⁸⁹

With the exception of Project Talent, a twenty-year study conducted by the American Institute of Research, NLSMA was recognized as “the most ambitious effort ever organized to attempt to determine the effects of school experience upon students.”¹⁹⁰ The manner in which is evaluated mathematics education from multiple perspectives, to look at mathematical abilities in the plural, and the measure multiple outcomes at each level was described by one participant as “the most original” part of the entire SMSG project:

That, of course, took a lot of testing and a lot of fancy designs and there were a lot of fancy statistics that came out of that. I think it was an original thing because, up to that point, people were just giving standard ETS co-op algebra tests and that sort of thing to determine whether one curriculum was doing something different from another. I think it was Begle's idea that we'll look at lots of different pieces of mathematics and see where the different curricula are doing better or worse. Now, maybe that idea came from elsewhere, I don't know, but it was certainly a feature

¹⁸⁵ Howson, Keitel, and Kilpatrick, *Curriculum Development in Mathematics*, 189-191.

¹⁸⁶ “Current Activities,” March 1965, 32.

¹⁸⁷ Howson, Keitel, and Kilpatrick, *Curriculum Development in Mathematics*, 189-191.

¹⁸⁸ Leonard S. Cahen, “An interim report on the national longitudinal study of mathematical abilities” *The Mathematics Teacher*, 56: 6 (October 1965): 522.

¹⁸⁹ Ibid.

¹⁹⁰ “Current Activities,” March 1965, 32.

of the Longitudinal Study that set it apart from some of the earlier efforts to compare curricula.¹⁹¹

NLSMA was carried out under the guidance of a panel of psychologists, mathematicians, teachers, and statisticians. Along with data analysis, SMSG used NLSMA data for the study and development of tests, “particularly those concerned with the more subtle goals of mathematics.”¹⁹² By 1967, SMSG was nearly exclusively engaged with just two major activities: 1) continuation of NLSMA, and 2) an experimental curriculum program centered on pedagogical concerns rather than traditional grade-level placement.¹⁹³

Though many evaluative measures in mathematics assessed individual curricular projects (notable examples such as NLSMA aide), increasingly evaluation was undertaken on multiple programs, across multiple schools, and across state and national borders. By the mid-1960s the NSF funded a comparative study of conventional mathematics and the “new math” programs developed by SMSG, UICSM, Ball State Teachers College, and the University of Indiana. To this end, a grant was awarded to the Minnesota Academy of Sciences, in cooperation with the Minnesota State Department of Education and the University of Minnesota, to oversee 425 experimental classes in North and South Dakota, Iowa, Minnesota, and Wisconsin. Data collected focused on “achievement in mathematics, attitudes, and interrelationships of these factors with characteristics of teachers through new tests and direct classroom observation.”¹⁹⁴ Along with the NSF, other organizations sponsored large-scale assessment programs in mathematics—such as the National Longitudinal Study of Mathematical Abilities at Stanford University the Institute for Mathematical Studies in the Social Sciences (also at Stanford), and the Research and Development Center for Cognitive Learning at the University of Wisconsin—to acquire appropriate knowledge to effect future curricular developments.¹⁹⁵ The National Institute of Education, established in 1972, almost immediately initiated one of the more influential studies of mathematics education at the time, the Missouri Mathematics Effectiveness Project. This project was an effort to better understand the relationship between process—classroom teaching—and product—student achievement outcome. This research heavily utilized the standardized test as a way of measuring student achievement.¹⁹⁶ In the years to come such studies as those by the NSF

¹⁹¹ Jeremy Kilpatrick, oral history, , 31-32. ,

¹⁹² Leland B. Haworth to Members of the National Science Board, memorandum, “Proposed Course Content Improvement Project,” November 2, 1965, 3. Course Content Improvement Program (1965-1977) (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

¹⁹³ Bennington to Haworth, memorandum, August 19, 1968, 4.

¹⁹⁴ “Current Activities,” in National Science Foundation Education Divisions, “Status Report on the Course Content Improvement Activities of the National Science Foundation,” March 1965, 33. NSB Commiss. on Precollege Education – Status Report on Course Content Improvement Act; Box 7; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

¹⁹⁵ Thomas A. Romberg, “Curriculum, Development, and Research,” in National Council of Teachers of Mathematics, *The Teaching of Secondary School Mathematics: Thirty-third Yearbook*, (Washington, DC: National Council of Teachers of Mathematics, 1970), 78.

¹⁹⁶ John Woodward, “Mathematics Education in the United States: Past to Present,” *Journal of Learning Disabilities* 37:1 (Jan/Feb 2004): 18.

and the NIE would be replicated across larger and larger scales in the effort to assess—and standardize—education across the United States.

Mathematics education offered a particular useful medium for the increasing attention to evaluation and assessment at all levels. For one, the mathematics education community shared a collective appreciation for the development of sophisticated evaluative methods. The coherence of the community in this regard is described by James Herbert in his oral history, who during his time working at the College Board worked with mathematicians in developing standardized, nationally-distributed tests:

Mathematicians aren't afraid of testing. They—I always found that the mathematicians were very able to discriminate good testing from bad testing. And so they weren't worried about formulating outcome statements in a way that could be turned into test specifications. No problem. They wanted to formulate outcome statements that were sufficiently cognitive, that were sophisticated skills so you couldn't look for an algorithm or something like that. I think they succeeded pretty much.¹⁹⁷

Though this disciplinary coherence alone might have beneficially impacted education reform in mathematics, it is the fact that such testing programs could be so readily adopted for the aims of larger education reform in this country that ultimately rendered the mathematics education community such an important contributor to the history of American education. Herbert describes the nature of this relationship between the testing and evaluation methods developed by the mathematics education community and the interests in federal education reform more generally:

commonly there's this perception that these numbers are the same, they're equal in all cultures. So you can give a test people all across the world and get these results back and just compare them and not have to worry about any of these hairy issues that you get in to in history standards for instance. It's very clear that that's not value neutral. And while it's not value neutral in math, I do think that there's still this really common perception, and perhaps even one at the policy-making level in Washington.¹⁹⁸

This symbiotic relationship—the one between the mathematics education community's interest in developing sophisticated evaluative techniques and the federal (and state) government's interest in collecting standardized data on education—would only strengthen throughout the remainder of the twentieth century, with both mutually influenced by the other.

¹⁹⁷ James C. Herbert, *Work in K-12 Education Reform: Student Competencies, Curriculum Assessment, and the Language of Reform*, an oral history conducted 2012, Regional Oral History Office, The Bancroft Library, University of California, Berkeley, 2012, 43-44.

¹⁹⁸ James C. Herbert, *Work in K-12 Education Reform: Student Competencies, Curriculum Assessment, and the Language of Reform*, an oral history conducted 2012, Regional Oral History Office, The Bancroft Library, University of California, Berkeley, 2012, 37.

Assessment to Reassessment: Reevaluation of the New Math Projects

Though the relative “success” of new math programs is debated, popular memory of the program tends to recall the curriculum reform of the 1950s and 1960s as a failure—one participant in new math era reforms characterized atmosphere of the late 1960s as one permeated by the idea, “*everything was wrong with the new mathematics.*”¹⁹⁹ Yet this popular sentiment arose at the same time the mathematics community itself was beginning a large-scale reassessment of the past decade’s reform efforts. Increased attention to educational psychology and the emerging field of cognitive science, along with attempts to develop more accurate evaluative methods led many in the community to the understanding that far more attention had to be paid in future reform efforts to issues of pedagogy, learning theory, and the myriad of variables that impact student learning and achievement. This, no doubt, was somewhat disheartening within the mathematics education after such a flurry of activity; after all, Begle’s attitude was widely accepted that it was “much, much simpler to say *let’s write some new materials* than it is to *let’s do the instruction in a better way.*”²⁰⁰ Disheartening as this realization might have been to the mathematics education community, however, it was also a disappointment across the nation more broadly. By the middle of the 1970s, with the new math effectively understood to be dead (though many materials still lingered in the nation’s classrooms), the reassessment of the reform era of the 1950s and 1960s rendered that era something of a joke [Fig. 4].²⁰¹

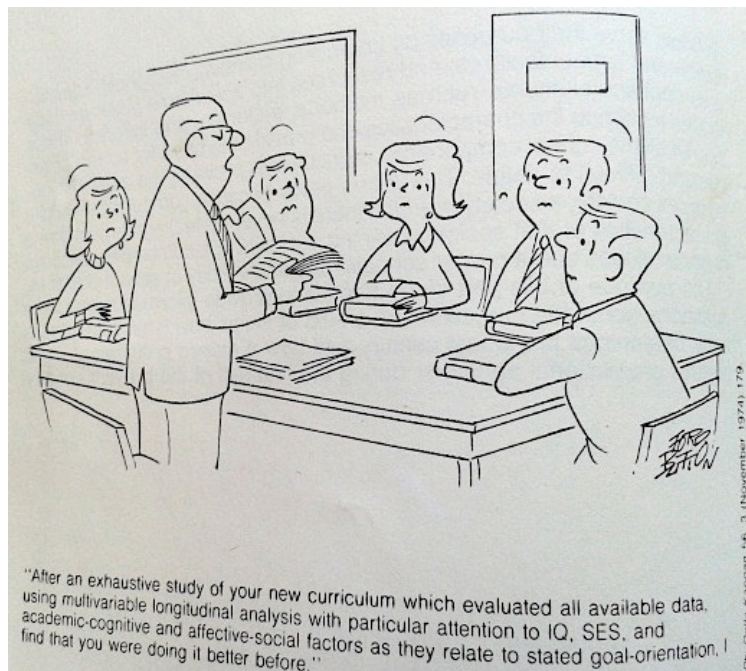


Figure 4

¹⁹⁹ James Wilson, interview with Dave L. Roberts, (University of Georgia, May 24, 1999), 37. National Council of Teachers of Mathematics Oral History Project. Archives of the American Mathematical Association, University of Texas at Austin.

²⁰⁰ Ibid., 74.

²⁰¹ *Phi Delta Kappan* 56:3 (November 1974), 179. Reprinted in Donald E. Orlosky and B. Othanel Smith, eds., *Curriculum Development: Issues and Insights*, (Chicago: Rand McNally, 1978), 2.

In this climate, many began calling for mathematics education to go “back to basics.” By the 1970s, fueled in part by a larger culture of conservatism that valued tradition [See Ch. 3], the “back to basics” curriculum largely supplanted the new math materials in American classrooms. Back to basics replaced the emphasis on discovery learning and structuralism with an emphasis on procedural skills of arithmetic and algebra, defined objectives, direct instruction, goals of mastery, and the use of standardized tests to judge the effectiveness of curricula, teaching, and schools.²⁰²

In their history of the new math, professors of education James Fey and Anna Graeber argue that the back to basics movement spurred “nearly a decade of retreat from core ideas of the new math movement before many of its progressive themes would reappear on the center stage of school mathematics.”²⁰³ While this assessment is relatively accurate if considering actual curricular materials in the classroom, one must take care not to assume that such a retreat occurred from within the mathematics education community itself. In fact, the coherence of the community in its interests of pursuing progressive reform led the community to continue to actively engage in research—though less so development—in mathematics education reform. At the end of the 1960s, in fact, support for mathematics education continued to be strong at the NSF, with the following projects all receiving money as of the end of 1969 [Table 4].²⁰⁴

	Project Title	Grantee
1	U. Illinois Committee on School Mathematics	U. Illinois
2	Madison Mathematics Project	Syracuse U., Webster College
3	Experimental Teaching of Mathematics in the Elementary School	Stanford U.
4	Foundations of Mathematics for Elementary School Teachers	State College of Iowa
5	Improvement Project in Mathematics for Selected Groups	U. Texas, Austin
6	The Mathematics Aids Program	Educational Broadcasting Corp.
7	In-Service Films in Mathematics for Elementary School Teachers	Hunter College High School
8	Study of Mathematics Achievement in Grades K-3	Yale U.
9	MINNEMAST	U. Minnesota
10	UICSM: 9 th Grade Mathematics	U. Illinois
11	UICSM: Films for Training 9 th Grade Algebra Teachers	U. Illinois
12	Secondary School Mathematics Curriculum Improvement Study	Teachers College, Columbia U.
13	Preparation of Materials for Pre-Limit Calculus	Illinois Inst. Of Tech.
14	High School Course in Modern Coordinate Geometry	Wesleyan U.
15	Programmed Correspondence Courses in Algebra and Geometry Training of Secondary School Mathematics Teachers	U. Minnesota
16	Uses of Mathematics in Science Teaching	U. Illinois
17	SMSG	Yale U.
18	Cambridge Conference on School Mathematics	Educational Development Corp.

Table 4

The mathematics education community’s relative autonomy and stability, as well, rendered the community a serviceable partner to the NSF as its own education programs were reevaluated in the late 1960s and 1970s.

²⁰² Fey and Graeber, “From the New Math to the *Agenda for Action*,” 541.

²⁰³ *Ibid.*, 538.

²⁰⁴ National Science Foundation, *Course and Curriculum Improvement Projects*, US Government Printing Office, 1970. Course Content Improvement Program (1965-1977) (2); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

Mathematics curriculum reform projects by the mid-1960s had already undertaken numerous and sophisticated endeavors to evaluate the efficacy of curricular materials, address issues of learning theory in the development of curriculum and in classroom practice, and develop evaluative tools to assess achievement, motivation, and attitudes. This level of attention to evaluation was unique among the NSF's curriculum improvement projects, and indeed stood as a precursor to the evaluation of the family of NSF's projects. In March 1969, it was suggested to the NSB Programs Committee that a project to evaluate the NSF's CCI programs be established and supported. It was ultimately decided that an outside Advisory Committee for Science Education might undertake this task, with the NSF gathering the necessary data. At the same meeting an item was brought before the Programs committee that "involved the concern of members of the Task Force on apparently how little is known and understood about what motivates people to learn." It was agreed that one member would ascertain what Foundation-supported projects knew about the subject and how NSF projects might exercise leadership in this field. With mathematics curriculum projects already well-ensconced in research projects addressing such issues of achievement and pedagogy, the upcoming years would position the evaluative work in mathematics education as a model of assessment practice.

In the summer of 1969 the Programs Committee met once again to clarify plans for the evaluation of CCI Programs. These plans, in fact, were determined to only constitute a "useful first step towards a more comprehensive evaluation of the results of the CCI programs funded by NSF."²⁰⁵ The purpose of this study was to recommend future research studies that might usefully be undertaken toward a more thorough evaluation of CCI Programs, as "it would be unwise to launch a more grandiose study until we have made the most of what is already known."²⁰⁶

The increased conservatism within the NSF to fund such programs was a reflection of the larger climate in which education reform was centered. The new math era programs emerged at a time when post-war and post-Sputnik concerns [see Ch. 5] allowed the NSF to spend more than \$500 million dollars on education in the 1960s. By the early 1970s, however, shortages of scientific personnel seemed less pressing, and furthermore the dissatisfaction with the Vietnam War led many to question the benefits that science and technology could bring to society. This came along with a general distrust of federal spending—which signaled federal intrusion—due to a collapse of confidence in the federal government in the wake of a persisting, unpopular war, rising inflation, and ultimately the Watergate scandal and the Iran hostage crisis.²⁰⁷ The 1970s would see a virulent reemergence of the federal-local debates that would have clear impacts on NSF programming in education [see Ch. 3].

In 1971, for instance, the CCI program was renamed the Curriculum and Instructional Development (CID) Program, in part to more specifically define the types of projects being funded. There also began to emerge some "sensitivity" to requesting

²⁰⁵ "Excerpt from Memorandum of Discussion, Fourth Meeting, NSB Programs Committee—May 15, 1969, Agenda Item 1: Report of Activities on Task Force on Science Education," undated, 1. Course Content Improvement Program (1965-1977) (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

²⁰⁶ Ibid., 2.

²⁰⁷ Maris Vinovskis, *From A Nation at Risk to No Child Left Behind: national education goals and the creation of federal education policy*, (New York: Teachers College Press, 2009), 13.

increased appropriations, with a sense that “a possible taxpayer revolt” might occur in the economic climate of the early 1970s.²⁰⁸ Nevertheless, the fiscal year 1972 budget was increased somewhat dramatically—by \$116 million—over the previous fiscal year’s allocation. Importantly, however, this increase was not felt across *all* programming at the NSF; President Nixon directed this funding toward “fundamental research necessary to our nation’s health,” in turn reducing support for “certain phases of science education and institutional programs.”²⁰⁹ A budget summary report for fiscal year 1972 shows the implications of this “reduced support”: from an estimated \$2 million allocation in fiscal year 1971 for Science Education for Students, the fiscal year 1972 budget was expected to fall to zero.²¹⁰ This likely contributed to the NSB Program Committee’s sharp turn in opinion of the CCI/CID programs from 1971 to 1972; in 1971 the Committee announced it was satisfied with the CCI program and reviewed a report stating that “the future of CCI was promising and one of NSF’s most important activities.”²¹¹ One year later, however, the Programs Committee “expressed concern for the progress of the entire program”—which at this point was beset with a drastic funding reduction—and “asked for an assessment of the future use of current materials to determine whether need is adequately filled.”²¹²

The CCI/CID Program faced some internal turmoil in those years. On January 22, 1973 the NSF’s Education Directorate was restructured by means of a memorandum issued from the office of the Acting Assistant Director for Education. The Curriculum and Instruction Development Program—formerly the CCI Program—became the Education Materials and Methods Development Session.²¹³ Two days later, however, the name was changed once more—the third change in two years—to the Materials and Instruction Development (MID) Section as a result of a memorandum requesting the modification so as to eliminate “possible unfortunate connotations in interpretation of a phrase such as ‘education methods.’”²¹⁴ Changes were not in title alone; a review of the MID Section later that year “stressed the changes in the overall Education program and how emphasis was shifting as a consequence, with thrust being toward modularization or

²⁰⁸ Report of the Meeting of the Advisory Committee for MPS, June 1-2, 1972, 2. MPS Advisory Committee Minutes, 1966-1972; Box 39; Records of the National Science Foundation, NSF Agency Historians Files, RG 307; NACP.

²⁰⁹ W. D. McElroy, NSF Director to [unspecified], Washington D.C., undated, 1-2. Office of the Director, 1968-75; Box 12; Records of the National Science Foundation, NSF Agency Historians Files, RG 307; NACP.

²¹⁰ “Budget Allocations by Major Activity and Program,” 1. Attached to W. D. McElroy, NSF Director to [unspecified], Washington D.C., undated. NSF Office of the Director, 1968-75; Box 12; Records of the National Science Foundation, NSF Agency Historians Files, RG 307; NACP.

²¹¹ “Brief Summary of the National Science Board’s Role in Pre-College Curriculum Development and Implementation Program,” May 2, 1975, 6. Course Content Improvement Program (1965-1977) (2); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

²¹² Ibid.

²¹³ National Science Foundation Division of Pre-College Education in Science, “The Materials and Instruction Development Section September 1973 – August 1974,” August 1973, ii. NSB Commiss. on Precollege Education Curriculum Improve. Program Sept. 1972-Aug. 1974; Box 7; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

²¹⁴ L.O. Binder and Jerome Dean to Acting Assistant Director for Education, memorandum, “Change in Section Name,” January 24, 1973, in National Science Foundation Division of Pre-College Education in Science, “The Materials and Instruction Development Section September 1973 – August 1974,” August 1973, ii. NSB Commiss. on Precollege Education Curriculum Improve. Program Sept. 1972-Aug. 1974; Box 7; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

delivering ‘methods of education’ rather than on ‘tight course content.’” What had not changed, however, was the MID Section’s dedication to funding mathematics curriculum improvement projects despite a rather grim picture from Washington regarding education spending—it was stated at a September 1973 meeting of the Programs Committee that “elementary school mathematics would be high on the priority list [for the MID Section programming] for the next 2 or 3 years.”²¹⁵ Even as the NSF’s own programming in education was facing obstacles, the relative stability of the mathematics education community—along with the increasingly mutual interest between the two parties in directing educational research toward issues of cognition and assessment—provided the NSF education programs a good partner in math education.

Though federal funding for education declined by about 65% between 1973 and 1975, projects in mathematics curriculum reform continued to maintain a foothold.²¹⁶ The importance of mathematics programs to the MID Section is demonstrated in the choice to include a report on “Programs for Improving Elementary And Secondary School Education in Mathematics” in a 1975 Annual Report, while other disciplines are not represented. In fact, the preface of this document states, “[i]nformation on science and social science projects in the Pre-College Division can be obtained by writing to the Foundation.”²¹⁷ This report also clearly displayed the preponderance of mathematics projects, listing 19 active grants in mathematics education projects, with 3 in biology, 8 in social science, 11 in interdisciplinary science, and 6 in “science (other).”²¹⁸ The majority of the mathematics education projects introduced during this period focused heavily on the mutual interests between the NSF and the mathematics education community in evaluation, data-collection, and research on learning. One evaluative program, *An Analysis of Operational School Mathematics Curricula*, sought answers to curricular questions through studying textual material, direct classroom observation, and clinical interviews. Preliminary results of this study suggested “sizable discrepancies between what children actually learn and what present curricula seek to teach.”²¹⁹ Further research was undertaken at the newly established Georgia Center for Research in Mathematics Education, said to represent:

²¹⁵ “Brief Summary of the National Science Board’s Role in Pre-College Curriculum Development and Implementation Program,” May 2, 1975, 7.

²¹⁶ Fey and Graeber, “From the New Math to the *Agenda for Action*,” 540.

²¹⁷ National Science Foundation Division of Pre-College Education in Science, “Programs for Improving Elementary And Secondary School Education in Mathematics,” 1975, preface, in National Science Foundation Division of Pre-College Education in Science, “The Materials and Instruction Development Section Fiscal Year 1975,” September 1975, Tab I. NSB Commission on Precollege Education Curriculum Improvement Program Sept. 1975; Box 7; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

²¹⁸ National Science Foundation Division of Pre-College Education in Science, “The Materials and Instruction Development Section Fiscal Year 1975,” September 1975, Tab D. NSB Commission on Precollege Education Curriculum Improvement Program Sept. 1975; Box 7; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

²¹⁹ National Science Foundation Division of Pre-College Education in Science, “Programs for Improving Elementary And Secondary School Education in Mathematics,” 1975, 4, in National Science Foundation Division of Pre-College Education in Science, “The Materials and Instruction Development Section Fiscal Year 1975,” September 1975, Tab I. NSB Commission on Precollege Education Curriculum Improvement Program Sept. 1975; Box 7; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

the beginning of a concerted, long-term effort to provide an understanding of the parameters involved in effective learning and teaching of mathematics at the pre-college level... The goal of the Center is to develop coordinated programs of research, both basic and applied, in well-defined directions. The intent is to develop a coordination of effort among many researchers with common interests.²²⁰

Another representative program funded by the NSF in mathematics education during this was the Conference on Piaget-Type Research. Focusing on research on learning, the conference “brought together 40 mathematics educators and 15 developmental psychologists interested in pursuing Piagetian research in mathematics education.”²²¹ Other projects that focused primarily on curriculum development included the National Conference on the Middle School Mathematics Curriculum, which was one of four NSF-sponsored conferences during the summer of 1973 that considered ways of improving school mathematics.²²² A project initiated at that relied on data-heavy experimental techniques was Stanford Mathematics Education Study Group, which examined mathematics education through strict experimentation with respect to variables:

During academic year 1973-74 the project investigated the extent to which a listing and review of prerequisite concepts, skills, and principles is provided; the extent to which nonexamples of the concept are included in student materials; and the number of practice items provided following the exposition of a skill, concept, or principle. The general procedure for each variable was preparation of two programmed versions of an appropriate mathematics topic that differed only in that one version has a high value of the variable under investigation while the other version had a low value. Investigations dealt at the fifth grade level with factors and primes and at the eighth grade level with probability. The programmed units for both levels were derived from programs developed in 1971 and 1972 by the School Mathematics Study Group (MSG) Research and Analysis staff to illustrate the canonical teaching procedures outlined in the final report of the MSG Panel on Research. Both of the original programs have been written in such a way that each of the instructional variables identified by the Panel on Tests was clearly evident and independent of other variables; thus each variable could be manipulated without affecting the others.²²³

Disadvantaged students, too, were addressed in experimental mathematics education programs during this time, primarily through Project SEED (Special Elementary Education for the Disadvantaged), which measured the impact of guided discovery methods (which had not, in fact, disappeared despite the popularity of the back to basics movement outside of the mathematics education community) on the self-concept of

²²⁰ Ibid., 5.

²²¹ Ibid., 1-2.

²²² Fey and Graeber, “From the New Math to the *Agenda for Action*,” 550-551.

²²³ National Science Foundation Division of Pre-College Education in Science, “Programs for Improving Elementary And Secondary School Education in Mathematics,” 3.

students in Gary, Indiana. SMSG, too, began a number of new sub-programs during this time, a long list of which includes the following projects:

- Project for the Mathematical Development of Children
- Mathematical Problem Solving Project
- Basic Research on How Children Learn Mathematics
- The Explorations into ways of Improving the Elementary Mathematics Learning Experience in a Small Subsystem of a Large City School System
- Unified Science and Mathematics for Elementary Schools
- Mathematics Resource Project
- First Year Algebra via Applications Development Project
- Ninth Grade Mathematics Course
- Source Book on Applications of Mathematics
- Development of Computer Simulation Materials
- Unified Modern Mathematics: Secondary School Mathematics Curriculum Improvement Study
- Demonstration and Experimentation in Computer Training and Use in Secondary Schools
- Modern Coordinate Geometry

Clearly, mathematics education projects—conveniently suited for experiment, work in elementary education, adaptability for testing, and applicability in learning theory—received much interest and funding from NSF education programs even as federal spending on education was increasingly both financially uncertain and popularly criticized. The mathematics education community was able to offer to the NSF a coherent, useful, and stable partnership—one that would become increasingly cooperative in the remaining years of the twentieth century.

Conclusion

In 1965, at the height of NSF education reform programs, a status report of the CCI programs included a section on “future implications” that looked ahead to later NSF programming in education reform:

[precollege education] reform is underway and its support outside the Foundation is a growing likelihood. The extent to which the Foundation should be involved in this movement, say, ten years hence will depend on a number of factors: progress achieved at any given time; the activities of other agencies, both public and private; and, viewed against that background, the ability of the Foundation to contribute new and imaginative ideas.²²⁴

²²⁴ “Future Implication,” in National Science Foundation Education Divisions, “Status Report on the Course Content Improvement Activities of the National Science Foundation,” March 1965, 44. NSB Commiss. on Precollege Education – Status Report on Course Content Improvement Act; Box 7; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

With that “ten years hence” fast approaching, the mathematics education community joined the NSF in a self-evaluation of the past years’ reform efforts. In 1974, the Conference Board of the Mathematical Sciences appointed a seven-member National Advisory Committee on Mathematical Education (NACOME) to prepare an overview and analysis of precollege mathematics education in 1974.²²⁵ The study was charged with analyzing each of the factors cited in the above recommendation from the NSF as published in 1965—though there is no indication that this overlap was conscious, and most likely simply indicates dovetailing of similar concerns in educational evaluation. The NACOME report outlined three areas of its study:

1. Goals for mathematical education as expressed in State and local school curricula, in innovative teaching and curriculum projects, and in reports of recent research and development planning conferences;
2. The predominant and innovating patterns in current school mathematics course offerings, teaching methodology, and teacher preparation;
3. The patterns of student mathematics achievement as reported in recent large scale evaluation studies (NAEP), State assessment data, and pertinent research.²²⁶

The results were not entirely favorable. The final NACOME report, published in 1975, demonstrated the lack of incorporation of new math concepts into the elementary school curriculum.²²⁷ While perhaps disappointing given the scope of the reform efforts in the 1950s and 1960s, the report noted that the “principal thrust of change in school mathematics [was] fundamentally sound.”²²⁸ The new math, while not achieving the success that many hoped for, was nevertheless deemed to have been a worthwhile pursuit. At the same time, the NSF was undergoing a series of internal and external reviews of its education reform projects more broadly following a controversy around one of its curriculum development projects [see Ch. 3]; the results were even grimmer, with NSF education programs in curriculum development nearly decimated by fiscal year 1976.²²⁹ The mathematics education community would, in the immediate future, need to draw upon internal unity should it support continued work in education research and reform. With a long tradition of coherence, however, the community had a secure structure in place to undergird the community’s aims and activities independently from larger, national efforts such as those of the 1950s and 1960s.

The upcoming years would see a shift in focus and leadership within the mathematics education community addressing some of the problems uncovered in the NACOME report. For one, the report indicated that student outcomes were heavily tied to classroom practice. This led to the increased awareness that the new math-era curriculum reformers “had too little appreciation for the critical role of classroom teachers,” both in

²²⁵ Fey and Graeber, “From the New Math to the *Agenda for Action*,” 533.

²²⁶ National Science Foundation Division of Pre-College Education in Science, “Programs for Improving Elementary And Secondary School Education in Mathematics,” 1.

²²⁷ Gates, “Perspective on the Recent History of the National Council of Teachers of Mathematics,” 741.

²²⁸ As quoted in Fey and Graebner, “From the New Math to the *Agenda for Action*,” 534-535.

²²⁹ Wayne W. Welch, “Twenty Years of Science Curriculum Development,” *Review of Research in Education* 7 (1979), 287.

terms of their role in adopting materials as well as the responsibilities they carried for adapting to materials. Reform efforts in the upcoming years would not only work more closely with classroom teachers, but would in fact be guided by them. The NCTM, a relative bystander during the new math, would take advantage of renewed interest in pedagogy over content and step forward to take the lead in the next generation of reform efforts [see Ch. 4]. Secondly, the mathematics education community would address the problems of curriculum dissemination that were uncovered by the NACOME report. In the upcoming decades the community would work alongside federal education efforts, both using policy changes to push forward reform and in turn wielding influence to shape the nature of education policy in the United States.

CHAPTER 3

THE ANTHROPOLOGY OF REFORM: MACOS and a Shifting Role for Mathematics Education Reform at the National Science Foundation

As demonstrated in Chapter 1, the mathematics education community during the new math era functioned as an autonomous unit within the context of education reform more generally. Yet the context in which mathematics education reform unfolded is of course embedded in an even larger context; while decisions made and actions undertaken can be understood in a general context of federal politics and Congressional oversight, mathematics education reform must also necessarily be placed in the context of larger societal trends and sentiments. In this chapter curricular reform in mathematics is explored as it intertwines with the broader public consciousness, specifically through a controversy surrounding the NSF's involvement in a contentious anthropology curriculum project that serves as a case study to shed light on the role of the mathematics education reform community in education reform in America more generally. What began as a somewhat small issue surrounding the distribution of royalties from small-scale publishing of curricular materials ultimately became the crystallization point for much larger concerns. As the NSF was situated centrally in national debates about the limits of federalism, work done in mathematics education reform increasingly offered a model for increased federal intervention in education even as conservatism replaced the more traditionally liberal attitudes of the early years of curriculum reform.

It might seem peculiar that the perceived failures of an anthropology curriculum program would propel mathematics curriculum reform into a leadership position for education reform; indeed, the literature on MACOS nearly exclusively focuses on the controversy's impact on science education more generally. Yet the double-pronged opposition to *Man: A Course of Study* (MACOS)—both in what was seen as objectionable content in a conservative climate and a flagrant overstep in federal intervention in education—positioned mathematics education reform as pivotal as the nation ultimately moved toward unprecedented federal control through No Child Left Behind legislation early in the 21st century. Mathematics education, for one, was seen as much safer than some of the other sciences; while MACOS was popularly criticized for including content such as senicide and abortion, the typical mathematics classroom could quite easily avoid such topics, even if curricular materials did aim to be more socially relevant. The history of detailed data collection on curricular efficacy and student achievement, too, placed mathematics education at the center of post-MACOS efforts to reevaluate course content improvement projects in the context of the needs and preferences of the American public. Post-MACOS mathematics education reform came to offer a clear model for strengthening federal involvement in education while maintaining the state and local autonomy that was heartily defended during the MACOS controversy. In the climate of 1970s and 1980s conservatism, mathematics education helped pave the way for the development of federal education policies with strong bipartisan support by the end of the century. This chapter helps underscore the mutual relationship between the mathematics education community and federal education

policies, as the case example of the MACOS controversy demonstrates both interdependence and coexistence in various contexts.

The Federal Government Enters the Classroom

Although there were some precedents—some even pre-dating the Constitution—that confirmed federal interest in education, the tradition of state and local control of education remained the status quo in the United States. Nevertheless, the NSF Act specifically directed the agency to “to develop and encourage the pursuit of a *national* policy for the promotion of basic research and education in the sciences” (italics added).²³⁰ From this charge, the NSF—and by extension the federal government—began, if hesitantly, to support science and mathematics education. From the start, however, this arrangement drew criticisms, with some arguing that a federal agency had no legal right to influence school curricula; others rebutted that the time had come for an agency such as NSF to enter into educational activities, in part due to rising anxiety about the status of American precollege education as outlined by popular sources like Bestor’s *Educational Wastelands* (1954).²³¹

In November 1955, a White House conference on education demonstrated increasing and widespread interest in greater federal aid for public schools.²³² In part this was bolstered by a sentiment of Soviet competition in the early years of the Cold War, a sentiment that manifested in the NSF’s increased budget for improvements in high school science and math instruction. The launch of Sputnik only accelerated these fears of decline, at the same time increasing federal involvement in education. In large part a response to Sputnik, the United States government passed the 1958 National Defense Education Act (NDEA), which effectively legislated federal involvement in K-12 education in science, mathematics, and foreign languages—all subjects considered crucial in winning the Cold War. In particular, Title III of NDEA provided for federal grants for the purchases of laboratory equipment, classroom materials, and updating science facilities. These grants, to be matched by states or local school jurisdictions, created an avenue for schools to supplement instructional materials and replace outmoded curricula with newly developed science and mathematics courses.²³³ Many of these courses were developed through the help of NSF funding.

In many ways, the NSF embraced the chance to support new high school math and science courses, as revamping content and updating pedagogy was seen to serve both the best science and help build the supply of scientists and engineers understood to be crucial for Cold War defense and maintaining a prosperous national economy. Beginning in 1957 the NSF began formally budgeting for programming that supported the improvement of course content materials [See Ch. 2]. In a review of the agency’s Course Content Improvement (CCI) Program, the associate director for education at the NSF, Henry Riecker, described the overall aim of programming in this area:

²³⁰ J. Merton England. “The Federal Interest in Secondary School Science and Mathematics—the View from the NSF” undated, 3. NSB Commiss. on Pre-college Education in Math, Sci. + Techn. (Development File) [2]; Box 1, Course Content – Development File; Records Relating to the Commission on Precollege Education in Mathematics, Science and Technology, 1965-1982, RG 307; NACP

²³¹ Ibid., 5.

²³² Ibid., 8-9.

²³³ Ibid., 13.

At that time [1957], many textbooks, especially at the high school level, were out of date and ineffective. The Foundation's purpose in this program area has been to secure the active involvement of leading scientists in the development of new courses, texts, educational films, and teaching aids of other sorts which represent the current knowledge and practice of science arranged in a challenging and teachable form.²³⁴

In the first eight years of the program, the NSF poured many of its resources into course content improvement. The following table [Table 5] outlines the expenditures from 1957 to 1964, organized by discipline.²³⁵

	1957	1958	1959	1960	1961	1962	1963	1964
El. & Jr. high math			\$440,930	\$305,000	\$198,720	\$835,180	\$899,505	\$1,261,560
El. & Jr. high sci		\$4860	\$117,980	\$150,660	\$5,000	\$912,060	\$1,606,060	\$2,293,830
Scndry math		\$100,000	\$838,750	\$1,493,350	\$1,414,700	\$950,770	\$793,500	\$1,754,870
Scndry sci totals	\$497,000	\$524,925	\$2,671,075	\$2,573,275	\$1,477,390	\$3,184,360	\$2,884,157	\$1963,880
Scndry bio	\$52,000	\$3,500	\$742,225	\$1,280,000	\$362,540	\$2,022,600	\$1,836,460	\$988,710
Scndry phys.	\$445,000	\$505,750	\$1,800,100	\$350,000		\$200,650	\$167,600	\$325,920
Scndry earth sci				\$14,950			\$198,472	\$584,340
Scndry chem		\$15,675	\$128,750	\$928,325	\$1,114,850	\$961,110	\$681,625	\$64,910
Scndry interdis.			\$14,000			\$106,800	\$9,100	\$28,680

Table 5

A closer examination of this chart indicates that funding toward elementary and junior high mathematics curricula was only 77% of that allotted for science curricula, yet it is important to understand that science instruction at that level is generally taught as “general science” of some type. Curricular development with the “active involvement of leading scientists,” as described by Riecker, would require representatives from a number of arguably disparate fields in a manner not paralleled in mathematics curriculum

²³⁴ Riecken to Associate Director (SPE), June 15, 1964, “Review of Course Content Improvement Program.” Course Content Improvement Program (1965-1977) (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

²³⁵ “Summary of Support for Course Content Improvement,” Table 14, in National Science Foundation Education Division, *Status Report on the Course Content Improvement Activities of the National Science Foundation*, March 1965, 24. Status Report Course Content Improvement Act; Box 7; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

development, which generally involved participants from a more coherent disciplinary background. When examining the data for secondary school curriculum improvement funding, then, it is clear that funding for mathematics materials surpassed that for any *individual* science. In the eight years following the establishment of the Course Content Improvement, secondary school mathematics curricula improvement received over \$7.3 million, a figure exceeding the totals for any individual science by at least \$60,000.

Clearly the NSF felt comfortable wielding influence in the development of curricula in mathematics. Yet in the position of a federal agency, the NSF necessarily trod carefully. By October 1963 the National Science Board (NSB) began expressing concern about the stability and fiscal responsibility of groups receiving grants from the Course Content Improvement Program, in particular the financial relationship between grantor—the NSF—and grantee.²³⁶ Importantly, all of the recommendations from the Board supported the philosophy of remaining as hands-off as possible in both the development and implementation of NSF-funded course materials. While the Foundation was charged with funding the early stages of curriculum development, the dissemination of those materials—at least in the long term—was not to be the responsibility of the NSF. Of course, it was not the intention that NSF-funded curricular materials would languish post-production; while the Foundation was discouraged to blatantly promote (or underwrite) new textbooks or curricula, it could “work in piecemeal fashion and indirectly through colleges and universities, scientific organizations, and individuals” to promote materials—one common way of doing so was through offer such institutes that increased teachers’ knowledge and proficiency and familiarity with the curricular materials.²³⁷

This careful strategy, however, would soon change.

By the 1970s, the NSF had replaced some of its discipline-centered institutes for teachers with projects for and meetings of school officials, with the aim of encouraging school systems to adopt NSF-funded math and science curricular materials.²³⁸ Though no coercion took place, this involvement was seen as a stronger—and often unwelcome—federal intervention in schools than that of previous years. This growing tension came to a head in 1975 with the very public critique of an NSF-sponsored junior high anthropology course known as Man: A Course of Study, or MACOS. Though much of the rhetoric surrounding the controversy referenced presumed “immoral” or “inappropriate” content, what would prove to be most damaging to the NSF’s involvement in math curriculum reform was the ways in which the agency failed to respect the traditions of state and local control in educational matters.

Establishing MACOS

The MACOS program, designed in consultation with academicians, was an attempt to bridge the gap between science and the classroom, and explored ideas such as student

²³⁶ “Brief Summary of the National Science Board’s Role in Pre-College Curriculum Development and Implementation Program” May 2, 1975, 2. Attachment to Anderson to Members of the National Science Board, “Course Content Improvement – Material and Instruction Development,” May 5, 1975. Course Content Improvement Program (1965-1977) (2); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

²³⁷ England, “The Federal Interest in Secondary School Science and Mathematics,” 15.

²³⁸ *Ibid.*, 21.

directed inquiry, new media, and nondidactic pedagogy.²³⁹ The National Science Board (NSB) first approved the initial proposal on September 13-14, 1963, providing \$513,360 for 15 months. In its approval, the NSB noted:

All grants being made in the Course Content Improvement Program which involve possible royalties from sales or rentals of films provide that such 'income' is to be placed in escrow accounts to be used as directed by the Foundation. Such funds may be required to be returned to the Foundation and, up to the amount of the grant, may be used for its general purposes.²⁴⁰

This statement, specifying that income derived from the distribution of curricular materials must be kept separate from other funds, demonstrates the early cognizance of the NSF any appearance of direct dissemination of curricular materials through the federal government—signaled by capitalist-driven incentive—must be avoided.

The Harvard psychologist and cofounder of the institution's Center for Cognitive Studies, Jerome Bruner, began the initial work on this anthropology course for ten-year-olds. Bruner was chosen for this project based on his extensive work on cognitive development in young children. A rationalist, Bruner espoused "discovery learning" and teaching the student how to think. Although influenced by Piaget, Bruner's criteria for mastering material led him to the conclusion that *any* learner was capable of learning material, specifically through a combination of student discovery and teacher organization of a conceptual framework.²⁴¹ This and similar educational philosophies came to characterize nearly all of the curriculum projects of the 1960s and early 1970s,²⁴² with his work helping to "operationalize a discipline-centered reform movement in American education. What began as shrill rhetoric resulted in widespread implementation of curriculum materials in American classrooms, and thereby changed in significant ways the substance of science education for many children."²⁴³ It was exactly this widespread implementation of curriculum materials—specifically federally-funded curricular materials—that ultimately led the NSF into trouble. As foundational principles guiding NSF curricular programs entered a large number of the nation's classroom—whether through specifically NSF-funded materials or simply those influenced by them—many saw this as an overreach of federal power.

As director of the MACOS project, Bruner sought to create a one-year curriculum for fifth-graders as prototype for what he hoped would ultimately extend into a twelve-year curriculum. He looked to create a highly interdisciplinary program in the spiral curriculum model, and was explicit in his aim of combining contemporary social needs with traditional education in the classroom.²⁴⁴ The idea that disciplinary content should

²³⁹ Peter Dow, *Schoolhouse Politics: Lessons from the Sputnik Era* (Cambridge: Harvard University, 1991): 4.

²⁴⁰ "Brief Summary of the National Science Board's Role in Pre-College Curriculum Development and Implementation Program," 2.

²⁴¹ Schulman, Lee S. "Psychology and Mathematics Education" in Begle, Edward. *The Sixty-ninth Yearbook of the National Society for the Study of Education*. Chicago: University Press, 1970.

²⁴² Dow, *Schoolhouse Politics*, 5.

²⁴³ Peter S. Hlebowitsh and William G. Wraga, "The Reemergence of the National Science Foundation in American Education: Perspectives and Problems," *Science Education* 73:4 (1989): 405.

²⁴⁴ Dow, *Schoolhouse Politics*, 77.

address timely societal problems was not somewhat new, but deepening unrest about domestic issues in the 1960s and 1970s led many educational reformers to call for exactly this kind of course content—content that dealt with the pressing problems of the time, like air and water pollution, urban decay, poverty, civil liberties.²⁴⁵ Though many felt that MACOS content addressed these issues poorly, the very fact that the curricular materials addressed larger cultural concerns propelled the MACOS project into the public spotlight as debates over education reform resurfaced in a changing political climate.

Just as there was in science, there was an early push to revise social studies to make course content less about textbooks and more engaging for students.²⁴⁶ In January 1962, Jerrold Zaccharias, head of the Physical Sciences Study Commission (PSSC)—which also ran the small corporation, Educational Services Incorporated (ESI), that oversaw curricular reform projects—recommended that a social studies (broadly defined) curriculum program be established. Following this recommendation a number of projects were initiated, including Project Social Studies and the precursors to MACOS—that aimed to pair social studies with the empirical and cognitive dimensions of learning, bridge research with teaching, and develop teacher-proof materials.²⁴⁷

The MACOS project stated a five-fold purpose: (1) to give students respect for and confidence in their own mental abilities; (2) to use that confidence and power to think about the human condition; (3) to provide simple models to help students analyze the nature of the social world; (4) to impart a sense of respect for the capacity of humanity; and (5) to leave students with a sense of the boundlessness of evolution. To organize the material, three basic questions were strung throughout the curriculum: (1) What is human about human beings? (2) How did they get that way? and (3) How can they be made more so?²⁴⁸ The curricular materials included film, archaeological materials, and activities such as roleplay to demonstrate to the students that man is unique, yet patterns of social interaction can be effectively compared to those within the animal kingdom. In the first half of the class students studied non-human species such as salmon and baboons. In the second half they studied “less-developed human culture” such as the Netsilik Eskimo. Bruner’s proposal was not seamless, but many found his ideas stimulating. Many also found the approach unsettling.

In January 1965 a second MACOS proposal was submitted to the Board. This proposal was reviewed and approved, granting \$1,829,903 for a Social Science Curriculum project under Bruner for twenty months. Prior to approval, the Board considered a number of questions. One question was to what extent Educational Services Incorporated (ESI)—the grantee organization overseeing MACOS—was financially dependent on the NSF. The Board ultimately determined that although the NSF had supported a large total amount to ESI, these funds supported individual projects (such as MACOS) and not the organization as a whole. Another question posed by the Board was who was to benefit from the sales of educational materials—a central question when

²⁴⁵ Ronald W. Evans, “National Security Trumps Social Progress: The Ear of the New Social Studies in Retrospect,” *The New Social Studies: People, Projects, and Perspectives*, edited by Barbara Slater Stern, (Information Age Publishing, 2010), 17.

²⁴⁶ Ronald W. Evans, “National Security Trumps Social Progress: The Ear of the New Social Studies in Retrospect,” *The New Social Studies: People, Projects, and Perspectives*, edited by Barbara Slater Stern, (Information Age Publishing, 2010), 10.

²⁴⁷ *Ibid.*, 11.

²⁴⁸ Larry Kraus, “The Fight Over MACOS,” *The New Social Studies: People, Projects, and Perspectives*, edited by Barbara Slater Stern, (Information Age Publishing, 2010), 314.

considering the various stakeholders in disseminating curricula. To this question the Board settled on the answer being varied and dependent upon circumstances, but crucially all income would be kept separate from other funds.²⁴⁹

Though the second MACOS proposal was ultimately approved and the Board found the questions that arose to be satisfactorily answered, issues surrounding the Course Content Improvement Program were revisited in future meetings of the Board. In March 1965 the NSB agreed that the Foundation should reserve the right at all times to terminate CCI projects to avoid monopolization. This gave the Foundation the responsibility of judging if NSF-funded materials were exhibiting too much influence on the classroom—though NSF programs of course sought to develop sophisticated materials, any sense that the federal government was underwriting a national curriculum needed to be avoided. Such a policy had other benefits—it would discourage arbitrary rules limiting support to a certain number of years when funds could be granted, as some members of the Board argued this could “exclude certain desirable continuations or extensions of programs.”²⁵⁰ Basically, there need not be preemptive limits placed on the duration of funding that the NSF could grant; instead, the Foundation was charged with setting funding limits based on individual terms of development. Such considerations were formalized in May of the same year when the Board thoroughly reviewed its policies on CCI projects, ultimately agreeing that: “(1) CCI Projects should be an initial venture to be transferred later to outside groups; (2) responsibility for stimulating and supporting such a program resides in the Federal Government; and (3) career curriculum improvement groups should be avoided.”²⁵¹ These policies make clear the NSF’s indirect role in classroom reform, stressing that curricular development is only to be the responsibility of the federal government—though indeed it *is* its responsibility—in the early stages of development and only through terminal projects, with subsequent work and dissemination resting with others.

Central to continued consideration of the NSF’s role in course content improvement were issues of materials distribution and royalties. In September 1965 the Board agreed to consider as a future agenda topic: “Further consideration of the policies and practice pertaining to distribution of course content improvement materials prepared with NSF subsidization.”²⁵² At a meeting of the Board the following March, the NSF Director reported that, in response to an inquiry regarding royalty income, “he had informed Dr. Glenn T. Seaborg that income must continue to be returned through NSF to the Treasury, as specified in the grant letter. Individual Board Members agreed with this position.”²⁵³ In June 1966, ostensibly in response to a growing recognition that the CCI Program would continue to raise questions, the Board requested that an annual review of CCI programs be submitted to the Board for detailed consideration and formulation of recommendations for action.²⁵⁴ The first of such reports was made in September 1966 and covered FY 1966.

²⁴⁹ “Brief Summary of the National Science Board’s Role in Pre-College Curriculum Development and Implementation Program,” 2.

²⁵⁰ *Ibid.*, 3.

²⁵¹ *Ibid.*

²⁵² *Ibid.*

²⁵³ *Ibid.*

²⁵⁴ *Ibid.*

Even as the NSB deliberated the function of federal involvement in course content improvement, particularly in terms of the Foundation's relationship to curricular materials, individual projects continued work in curriculum development. MACOS was no exception; by the summer of 1965, the program was ready for initial testing and observation. In early January 1966, the executive committee to the project, somewhat skeptical of Bruner's highly innovated and interdisciplinary approach, asked Bruner to prepare a report on the program to aid a grant proposal to the NSF to ask for extended funding. Bruner and his team embarked on a series of experiments and restructures of the program. In September, the Board approved a third MACOS grant to ESI for continued support of a 'Social Science Curriculum Project' under the direction of J. S. Bruner, E. E. Morison, and F. K. Patterson for \$1,597,000 for two years."²⁵⁵

Securing a publisher for MACOS materials

In the summer of 1966, Bruner attempted to secure a publisher for wider distribution of MACOS materials. By this time, MACOS materials were abundant; along with films and other media, print materials included a number of texts, teacher's guides, student activities, and other materials to support the microlesson format. From the outset, publishers were skeptical, and at the arrival of the deadline given by Bruner, none of the major companies had expressed willingness to support the program—a result of controversial subject matter, the multimedia format,²⁵⁶ teacher training requirements, and, simply, the cost of the publishing project.²⁵⁷ In the meantime, MACOS sought a distributor for its films, although this too was immediately unsuccessful. Without a publisher, MACOS turned its attention to teacher training, and secured NSF funding for the creation of regional centers for the dissemination of information about the program.²⁵⁸

At this time, the NSF was not in position to offer funds for publication costs. For one, the Board was still wrestling with the overall policy for involvement in curricular materials distribution. In early 1967, CCI staff first specifically articulated the Program's role in overseeing course materials, stating that its policy was to support CCI activities through a first revision of curricular materials. After this point, projects were to be "placed in the 'public domain' through the mechanism of free licensing, and future revisions could then be undertaken irrespective of the sources of support."²⁵⁹ It was not however, until a year later, in March 1968, that the Board agreed on a general policy for "publication procedures, production and distribution of materials, and income utilization for CCI".²⁶⁰

Because the federal support of the development of instructional materials raises new and difficult problems of public policy, the Foundation has devoted considerable attention and effort to the evolution of a publication policy that would take into account the varied interests involved in the

²⁵⁵ Ibid., 4.

²⁵⁶ Dow points out that there was a growing conservatism in the publishing industry, especially regarding new media. The mergers between technology firms with textbook publishers had proven to be less than ideal, and many publishing companies balked at getting involved. Dow, *Schoolhouse Politics*, 161.

²⁵⁷ Ibid., 159-161.

²⁵⁸ Ibid., 163.

²⁵⁹ "Brief Summary of the National Science Board's Role in Pre-College Curriculum Development and Implementation Program," 4.

²⁶⁰ Ibid., 5.

production and use of instructional materials and at the same time protect the autonomy of the educational institution or school system. In the development of this policy, the intention has been to make materials readily available to all who wish to use them in ways that take proper account of the public interest and of the interests of the potential users, of the grantees, scholars, and educators involved in carrying out the projects, and of the commercial producers of educational material.²⁶¹

This policy outlined the proper application of federal funds to support the development of materials and to provide information about them to potential users, but Foundation policy forbade the use of federal funds to promote the *adoption* of these materials. Complicating matters, however, the Foundation found acceptable the use of federal resources to support the training of resource people who could assist local schools in adopting NSF-funded curricula, presuming the schools autonomously—the key idea—chose to adopt them.²⁶² Profits, too, are clearly outlined in the Foundation's policy:

The fact of support of public funds has required that the Foundation monitor closely the arrangement for the production and dissemination of the materials in order to insure that those arrangements are in the public interest, and in particular that neither the individual authors nor the grantee institutions realize a profit from the sale of the materials.²⁶³

This policy avoided any possibility that the NSF could be accused of pushing curricular materials for financial gain. To oversee such policy, it was required that the grantee institution maintains an entirely separate account for income earned from the sale and rental of CCI-funded instructional materials. This income was directed to be forwarded to the Foundation and ultimately the United States Treasury. One exception to this rule was the sale of preliminary course materials intended for testing and receipt of feedback; in this case the grantee organization was permitted to use this income in a revolving fashion to fund additional copies of materials.²⁶⁴

All the while MACOS, which continued to be funded—\$528,400 was granted to the project in September 1968—remained without a publisher for its materials, a fact that certainly contributed to the CCI staff's sustained interest in hammering out a policy for the Foundation's involvement in publication. Despite well-founded concerns about the Foundation's involvement in publishing, the possibility that a heavily-funded project such as MACOS might disintegrate at the stage of publication was also something to be avoided. With a Foundation policy established, in 1969 MACOS turned to NSF for funding for the manufacturing and distribution costs of producing material for the expanding network of regional centers, universities, and participating schools. In May 1969, the NSF extended a line of credit of \$270,000 to cover in-house publishing

²⁶¹ "Policy on Publication, Production, Distribution and Income Utilization for the Course Content Improvement Programs," NSB-68-59, 1-2. Course Content Improvement Program (1965-1977) (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

²⁶² Ibid., 2.

²⁶³ Ibid.

²⁶⁴ Ibid., 5.

expenses, which was later returned after profits from the sale of materials proved sufficient.²⁶⁵ The search for an outside publisher continued, however, and in November 1971 the NSF revised—and further tightened—its policy regarding the disposition of income generated under education grants, likely in large part due to its publishing agreement with MACOS:

Income will be applied to offset costs of grant activities as well as costs of administration of the income-producing properties. When income is not expected to exceed \$10,000, the grantee may keep and apply to research and education in the sciences amounts remaining after offsetting costs. However, any income remaining after payment of costs, which exceeds \$10,000, will be remitted to the Foundation. With respect to contracts, income received will normally be applied to offset costs chargeable to the contract, and any income not so used shall be remitted to the Foundation.²⁶⁶

Conservatism and MACOS values

The tribulations of the search for a publisher were soon overshadowed by an increasing public dissatisfaction with both the content of the curriculum and the federal involvement in its creation and distribution.²⁶⁷ By the late 1960s, various interest groups were cooperating and trying to get full funding for all sorts of education programs (not just categorical aid), which raised concerns about an emergent “education-industrial complex.”²⁶⁸ This critique of creeping federal control certainly was not new in the education debates, however it reemerged at a time when larger cultural shifts were impacting the collective values of Americans. In the late 1960s, in part attributed to the ubiquity of the home television, Americans were bombarded with images of what many saw as a nation failed by liberal politics. Rather than fostering a Great Society, conservatives argued, President Johnson led a country beset by an unwinnable war, violent opposition to civil rights, rising crime rates, women demanding equal rights, and other seemingly moral indemnities like the legalization of abortion. In response, an increasingly vocal contingent of conservative evangelicals bemoaned “what they saw as an increasing drift toward a liberal secularism that undermined ‘traditional’ values in American society.”²⁶⁹ These ideas gained traction as many Americans began to question the liberal policies of the 1960s—by 1976 *Time* magazine dubbed the moment as the “Year of the Evangelical.”²⁷⁰ By the late 1970s these evangelicals were integrated into mainstream politics and society, joining and leading social, cultural, and economic conservatives, organized around hot button issues like school prayer and the teaching of evolution.²⁷¹

²⁶⁵ Dow, *Schoolhouse Politics*, 169.

²⁶⁶ “Brief Summary of the National Science Board’s Role in Pre-College Curriculum Development and Implementation Program,” 5.

²⁶⁷ Dow, *Schoolhouse Politics*, 5.

²⁶⁸ Gareth Davies, “Towards Big Government Conservatism: Conservatives and Federal Aid to Education in the 1970s,” *Journal of Contemporary History* 43: 4 (Oct. 2008): 628.

²⁶⁹ Dan T. Carter, “The Rise of Conservatism since World War II,” *OAH Magazine of History* 17:2 (Jan. 2003): 14.

²⁷⁰ Stephen Tuck, “Reconsidering the 1970s – The 1960s to a Disco Beat?” *Journal of Contemporary History* 43:4 (Oct. 2008): 618.

²⁷¹ Carter, “The Rise of Conservatism since World War II,” 14.

The MACOS project cannot be separated from this context, as it developed alongside the growing wave of conservatism in America. MACOS ultimately became a target on two fronts: for its content that was seen as contributing to the rapid demise of American traditional values, and as representative of the overextension of federal powers and unchecked federal expenditure. The objections to content fast-tracked the MACOS controversy to be highly public. In 1970 a Baptist minister took to the airwaves and read select passages from the MACOS curricular materials, thus publicizing the perceived immoral content of the program. While the passages chosen were not from *student* materials, but rather from the extensive background materials provided to teachers, the perception grew that the content of the widely-used MACOS curriculum was immoral and antithetical to traditional American values. Frequently cited objectionable content in the unfolding outcry against MACOS included senilicide, infanticide, gore on film, sex education, murder and cannibalism, polygamy, wife-swapping, religion-as-myth, evolution, and bestiality.²⁷² Though the vast majority of the curricular content was actually quite tame, the characterization of MACOS as replete with immoral content gained traction, with protests emerging across the country from Maryland to Texas to Washington state. As the content of MACOS raised the rankles of a growing number of Americans, the more important question of why the federal government was involved in its creation led to a fundamental questioning of the appropriateness of federally funded curriculum reform projects in general.

The National Science Foundation, facing such cultural obstacles, began redoubling efforts to clarify both the purpose of course content improvement and the role of the Foundation in effecting change in the classroom. A 1970 publication from the NSF, the *Course and Curriculum Improvement Projects* outlines the recent history of educational reform, emphasizing the gains made by such projects:

In the last few years, mathematicians, scientists, engineers, and educators have taken up these new educational challenges with great vigor. Working together, and aided by increasing public and private support for educational research and development, they have undertaken a number of fresh approaches to the improvement of school instruction in mathematics and science. ... The aim has been to see that instruction presents contemporary knowledge as well as contemporary viewpoints on knowledge established earlier. In many cases it has seemed best to start anew rather than merely to patch up older courses. A distinctive feature of many projects is the effort made to go beyond the presentation of what is known and to provide students with experience in the process by which new facts, principles, and techniques are developed.²⁷³

However, rather than immediately propose that the NSF was the appropriate centrality from which education reform should emerge, the authors of the document took a careful approach and acknowledged the autonomy of state and local educational entities. The

²⁷² Kraus, "The Fight Over MACOS," 318.

²⁷³ National Science Foundation, *Course and Curriculum Improvement Projects*, (Washington, DC: US Government Printing Office, 1970), iii. Course Content Improvement Program (1965-1977) (2); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

report assures that, “[d]ecisions on what to teach remain, in the healthy American tradition, the exclusive responsibility of individual schools and teachers. The National Science Foundation does not recommend the adoption of any specific book, film, piece of apparatus, course, or curriculum.” But it is the following passage that is characteristic of the entire controversy surrounding federal involvement in precollege education. The report goes on to state that, “[i]t is hoped, however, that the products of these projects will prove to merit serious consideration by all concerned with education at the pre-college level.”²⁷⁴ While those in support of NSF-funded—and other federally-funded—education initiatives would see this as merely common sense, as *of course* school districts should consider cutting-edge, expert-advised curricular materials; others would see this as no less than a bullying strategy of the intellectually elite and already-powerful government. It is this latter interpretation that would continue to grow, ultimately threatening the NSF’s influence in education reform.

Again, however, concerns about the limits of federalism were not new; what MACOS provided was the dual edged sword of objectionable content *and* federal implementation. In August 1971, an article was printed in the conservative and religious *Human Events* titled “What Educators are Doing with Your Federal Tax Dollars.” This article, directed specifically at the Montgomery County, Maryland schools but quickly was more broadly cited, accused MACOS of using public funds to teach the private values of the MACOS creators and threatening the moral value of humanity. In reaction, the school system in Montgomery County surveyed 167 school systems using MACOS nationwide. The results were overwhelmingly positive; out of the 134 districts that replied, one hundred evaluated the program as excellent, twenty-eight described it as good, and the remaining six were not using MACOS. None of those polled listed the course as “fair” or “poor.” The Montgomery County school board renewed MACOS for the upcoming academic year.²⁷⁵

Nevertheless, the growing conservatism in America was becoming more and more widespread in the 1970s, and MACOS was a clear target for those criticizing excess federal involvement in traditionally state and local affairs, as well as those who feared a demoralization of American values. Charges against school boards and books and articles denouncing MACOS and bureaucratic education policies all began appearing with more regularity. The widening scope of opposition to MACOS reached a climax when it was brought to the floor of Congress in 1972 by John B. Conlan, a representative from a conservative district in Phoenix. One of Conlan’s aides, George Archibald, had been personally interested in the MACOS controversy as it unfolded earlier in Phoenix. Archibald suggested this issue to Conlan on the eve of the latter’s reelection as a means of securing national visibility.²⁷⁶ In the wake of seeking reelection, Conlan brought down not only MACOS, but also the NSF’s education initiatives.

Conlan, a member of the John Birch Society, was a member of the House Committee on Science and Technology, which reviews the NSF budget and submits it to Congress.²⁷⁷ Conlan argued that the money that MACOS received in subsidies for

²⁷⁴ Ibid.

²⁷⁵ Dow, *Schoolhouse Politics*, 185.

²⁷⁶ Ibid., 199.

²⁷⁷ James Wilson, interview with Dave L. Roberts, University of Georgia, May 24, 1999. National Council of Teachers of Mathematics Oral History Project. Archives of the American Mathematical Association, University of Texas at Austin.

material distribution put it in unfair competition with private publishing enterprises. This was further complicated by the fact that, a few years earlier, Congress had mandated that the NSF needed to disseminate more educational programs, as it had been allotted federal funds to do so. Conlan turned this around, and was supported by Congressman Barry Goldwater, Jr. who spoke to Congress and questioned whether federal support should continue after the initial development period. Eventually, the NSF was granted a slight reprieve, as it was decided in Congress that the Foundation would simply need to appoint a review committee for the course before releasing any more funds.²⁷⁸ Nevertheless, the controversy made it clear that the NSF faced the possibility of being forced to dismantle its entire science education program if a compromise could not be met regarding the federal responsibilities for precollege education. The debates continued within Congress, as Conlan refused to submit to the more moderate proposal for NSF action.

By March 1972, the MACOS controversy was becoming public, and fierce words were flying about the role of the NSF. On April 9th, the NSF authorization bill returned to Congress, and Conlan reintroduced an amendment that required specific Congressional approval before NSF could promote or market any commercially available curriculum program. By a slim margin of 196-215, Conlan's amendment did not pass, but this was followed by an amendment introduced by Congressman Robert Bauman. This amendment, which did pass but by a similarly slim margin, required Congress to be fully informed of all grants NSF proposes to fund thirty days before contracts are signed.²⁷⁹ A second amendment was also passed with far greater support in the House; this legislation—the Myers amendments to H.R. 4723—required all federally-produced materials being introduced into local school systems to be available for public inspection and review. These impositions threatened to remove a great deal of authority—and at least, autonomy—from the NSF, instead transferring oversight to both Congress and parents. Though the Bauman amendment was later revoked, it provided a sense of great foreboding to the NSF, education reformers, and the scientific community at large, all of whom generally supported the model of education reform practiced by the NSF. Those supporting NSF solicited a General Accounting Office review of the Foundation with the hopes of clearing its name once and for all.²⁸⁰

Reviews—conducting concurrently by the House Committee on Science and Technology, the General Accounting Office, and the NSF itself—of the NSF's involvement in MACOS generally centered on the Foundation's lack of oversight of the programs. This was often cited as a benefit—it allowed the NSF to keep arms length from the controversy—but some saw it as highly irresponsible when millions of dollars were at stake. Though public debates fueled Congressional conversations, and these public debates largely centered on the objectionable content of the MACOS curriculum, the discussion in Washington was focused on something more fundamental to educational policy in America—the question of free choice within the educational community. The proper division of power between scientists, bureaucrats, citizens, and politicians fueled much of the discussion surrounding MACOS. Also, economic activity between the public

²⁷⁸ Dow, *Schoolhouse Politics*, 201-202.

²⁷⁹ “Statement of Dr. Onalee McGraw, Coordinator for the National Coalition for Children, Before the Senate Special Subcommittee on the National Science Foundation, Monday, April 21, 1975,” undated, 16. Curriculum Development – Copies of Congress. Corresp.; Box 7; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

²⁸⁰ Dow, *Schoolhouse Politics*, 233.

and private sectors was an issue best exemplified by the concerns over publishing rights. Finally, continuing in the tradition of Scopes-style issues, the question of which values—scientific or traditional—should dictate public life maintained a strong hold on the participants in the MACOS controversy.²⁸¹ These were big issues, and not likely to be solved quickly, even on the floor of Congress.

The NSF did not sit idly by while topics of relevance to the Foundation's work were discussed and criticized in Congress and in other private and public spheres. Organization shifted within the agency as a result of the discord, with the Course Content Improvement Program renamed the Materials and Instruction Development (MID) Program. This change was not in name alone, but also in mission; the staff of MID stressed, in their annual report to the Board in September 1973, changes in the overall emphases of precollege education programs at the NSF, "with thrust being toward modularization or delivering 'methods of education' rather than on 'tight course content.'"²⁸² In short, the NSF education programs were cautiously rejecting the development and promotion of tangible course materials, instead focusing on more blurry matters of pedagogy and technique. At a meeting a month later, Dr. Lowell J. Paige, Assistant Director for Education at the NSF, further outlined the Foundation's hands-off approach to disseminating course materials, a strategy aimed at creating precautions against favoritism and making materials readily available to competing publishers.²⁸³ He stated that commitments to course content improvement must extend to the point where program developers could say: "Here is curriculum material that our evaluations indicate is responsive to national needs; it is different; it is in sufficient quantity to be implemented today for your independent testing; and, if you find this material successful, we urge you to encourage commercial concerns to expand on NSF's pioneering efforts."²⁸⁴ He was not, however, optimistic of the educational impact such a strategy would have; not only would the Foundation step aside from promoting the curricular materials it supported financially and philosophically, but the agency, despite some popular opinion to the contrary, remained relatively powerless in effecting change. Paige reminded the Committee that "the Foundation is engaged in altering in ever so small an area a \$100,000,000,000 education establishment with a very small lever. 'Archimedes' task might have been easier by comparison," he concluded.²⁸⁵

MACOS Under Fire

Despite widespread criticism of the project across many venues, from Congress to conservative constituents, work on MACOS continued. In September 1973, sequential teaching of the four main units of the MACOS course began among thirty-nine teachers in twenty-nine schools. Participating classrooms were clustered in two general areas: one surrounding Boston and the other in the greater New York City area. All teachers were required to attend a summer workshop before initiating classroom teaching, and training

²⁸¹ Karen Wiley, *The NSF Science Education Controversy: Issues, Events, Decisions* (Washington, D.C.: National Institute of Education, 1976), 1.

²⁸² "Brief Summary of the National Science Board's Role in Pre-College Curriculum Development and Implementation Program," 6.

²⁸³ England, "The Federal Interest in Secondary School Science and Mathematics" 18.

²⁸⁴ "Brief Summary of the National Science Board's Role in Pre-College Curriculum Development and Implementation Program," 8.

²⁸⁵ *Ibid.*

continued throughout the school year. Feedback from these teachers on the teacher's guides, on the content and format of workshops, and on background reading materials was collected for use in determining the most effective teacher education strategies.²⁸⁶

In 1974 the NSF Director, H. Guyford Stever, recommended to the NSB that a twelve-month grant be approved for \$500,000—in addition to the total support already allotted to the program, amounting to \$1,986,890—to fund “Exploring Human Nature, a component of the MACOS project. In his memo, Stever assured the Board that the project had been reviewed for relevance to the Foundation’s resources allotted to science education, ultimately finding that “[t]he project staff is well qualified and is producing an imaginative, effective curriculum. The negotiated budget is reasonable for the work to be done.”²⁸⁷ A summary of the activities funded by the proposed grant was provided, including information on the production of curricular materials:

This grant will support the final development, testing, and evaluation of *Exploring Human Nature*, a secondary level interdisciplinary behavioral science curriculum... The final version of classroom materials and teacher's guides are now being produced for Units I and II. During the period of this grant, design and production of Unit III will be completed, as will revisions, format design and production of materials for Unit IV. Additional activities for the coming year include final cutting and editing of films, and final writing, editing, design, and production of both teacher education and community education materials. A full-scale evaluation of the course is planned, with final preparation of an Evaluations Strategies Handbook for Teachers and Students.²⁸⁸

The specific materials proposed for publication were a series of paperback booklets “containing theoretical and ethnographic readings and case studies, as well as suggested projects, classroom activities, and approximately three hours of films.”²⁸⁹

The support for this project is well documented in Stever’s memorandum to members of the Board. Included for review are quotes from “distinguished scientists and educators” that endorsed the educational model employed by MACOS. For instance, the President of the Carnegie Institution was quoted as being “extremely well impressed with [MACOS] on several scores.”²⁹⁰ A scientist at the Salk Institute for Biological Studies offered his general assessment of the proposal as high.²⁹¹ One curriculum coordinator for a Massachusetts high school lauded the benefit of having leading scholars shaping the selection of conceptual themes and choosing modern materials to illustrate them.²⁹² Perhaps most celebratory is the review from M. Brewster Smith, Vice Chancellor for Social Sciences at UC Santa Cruz: “This strikes me as a highly meritorious venture. The

²⁸⁶ Stever to Members of the National Science Board, “Course Content Improvement Grant Recommendations,” February 12, 1974, 7. Course Content Improvement Program (1965-1977) (2); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

²⁸⁷ *Ibid.*, A, 8

²⁸⁸ *Ibid.*, 1.

²⁸⁹ *Ibid.*, 4.

²⁹⁰ *Ibid.*, 6.

²⁹¹ *Ibid.*

²⁹² *Ibid.*

account of progress during the preceding year seems to me straightforward and persuasive: the proponents have been proceeding wisely, have drawn on social and behavioral scientists of very high quality for good advice, and have learned from their experience along the way.”²⁹³ A member of the Social Science Education Consortium mirrored the praise of the project’s underlying integrity in development:

The review of past work done on the project is enlightening to the reader, showing production underway on good materials, a good structure, a good variety of participative activities, and good procedures for evaluation and feedback to the developers. The participation of eminent scholars, able resource people, and good staff members is convincingly described and assured.²⁹⁴

The reviews of the MACOS were not positive across the board, however. A number of investigations and review boards were examining the NSF’s course content improvement programs in the wake of Congressional discussion. On May 1, 1975, the Assistant Director for National and International Programs at the NSF sent a memo to the Board alerting members that the internal review committee found information in the course of its investigation that was transmitted to the Department of Justice. Though further details were unfurnished, it was stated that the investigation uncovered “possible serious irregularities” by the subcontracted publisher.²⁹⁵

Though such findings did not bode well for the NSF’s involvement in precollege education, the Foundation’s position was already shaky. The ongoing investigations, reviews, and inquiries from Conlan and others nearly shut down the NSF Education Division by the end of 1974, according to scholar of math education, James Wilson, who was on staff at the NSF during the 1974-1975 year.²⁹⁶ Yet by mid-1975, the situation had reached a climax. In April, the Senate Special Subcommittee on the National Science Foundation met and listened to an impassioned plea to put an end to NSF intrusion into education matters. This speech, presented by Onalee McGraw, an appointed member of the National Council on Educational Research, a consultant for the conservative Heritage Foundation, and a representative from the National Coalition for Children—an informal association of parents organizations in 38 states—argued that something must be done at the Congressional level to rectify the facts that:

...in recent years parents have virtually lost control of what is taught and done in their elementary and secondary schools. Their inherent right to decide how schools can best serve the educational needs of their children has been usurped by a highly powerful organization of educators and the National Education Association. This well-organized, heavily financed

²⁹³ Ibid.

²⁹⁴ Ibid.

²⁹⁵ Hughes to Members of the National Science Board, “Review of the Pre-College Curriculum Program,” May 1, 1975. Course Content Improvement Program (1965-1977) (2); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

²⁹⁶ James Wilson, interview.

educationist complex is now virtually dictating education policy throughout America.²⁹⁷

Such policy, McGraw described, would lead to a moral relativism in the classroom, argued to increase teen vandalism and violence, uncivil behavior, and disrespect for adult authority. No rhetoric was spared in depicting the social ills the nation faces as a result of MACOS and other federally-funded instructional materials:

Alcoholism, drug use, an epidemic venereal disease rate, increasing pregnancy among pre-teen girls, abortions for young unmarried girls, a high divorce rate among young married couples, disdain for work ethic, callousness, cynicism, growing hedonism and belief in the occult, are all alarming results of declining moral values among young people induced by federally-subsidized school instructional materials based on “situation morality.” Richard Wheeler coined a frighteningly accurate phrase in his book by the same title when he described these young victims of the current education establishment’s classroom behaviorism as “The Children of Darkness.”²⁹⁸

As evidence for the direct impact on the student, McGraw referenced a family doctor who testified to the emotional trauma and psychological disturbance of some young children exposed the content of the MACOS course:

I first became interested in this course of study when a young 12 year old girl from a nearby city was referred to me because of severe anxiety, and insomnia, social phobia, and who began to have sexual obsessive thoughts. In therapy, I learned that this was brought about by the teachings and by the stories as recounted in the Macos Program.²⁹⁹

McGraw did allow that many might wonder how the NSF could possibly be held responsible for such a litany of accusations; this was answered simply—“because NSF is directly involved in an aggressive curriculum promotion and marketing program, using tens of millions of our taxpayers’ dollars, to induce local school districts to use certain instructional materials that seed ‘situational morality’ training in elementary and secondary classrooms.”³⁰⁰ Thus, perhaps even more dire than the injection of morals into the classroom was the usurping of power from state and local control, as McGraw feared that the “Foundation is using its education grants program to establish a nationwide uniform curriculum that will totally supplant what still remains of local autonomy, academic freedom, and diversity in education.”³⁰¹ Though the content of the MACOS program, seen to educate students “away from parental values” remained a component of McGraw’s opposition, it was the perception that the federal government was usurping

²⁹⁷ “Statement of Dr. Onalee McGraw,” 1.

²⁹⁸ Ibid., 3.

²⁹⁹ Ibid., 12.

³⁰⁰ Ibid., 4.

³⁰¹ Ibid.

local autonomy that was seen as the most pressing problem.³⁰² It certainly, too, was the one that would have the broadest impact on the National Science Foundation.

The NSF's role in the publication of curricular materials was central to McGraw's argument that the Foundation was pushing the bounds of federalism by asserting too much influence. Data was produced at this meeting that outlined the difficulty the MACOS problem had in securing a publisher, implying that it was simply not suitable for use in the classroom. Nevertheless, McGraw said, dissemination of the objectionable materials moved forward by government force:

Bureaucrats in NSF and EDC decided that MACOS must be put into schools nationwide, regardless of the need for it, that parents might object to its philosophy and content, or the course's commercial viability. They therefore set up a publisher for the course, made special royalty arrangements to make MACOS commercially viable, and started a sophisticated promotion and marketing campaign to sell and distribute the course to elementary schools in every state.³⁰³

The federal government, or specifically the NSF, was thus depicted as “strong-arming” local school districts to adopt the curricular material—despite objectionable “philosophy and content.” Attached to the meeting minutes is a chart [Fig. 5] that was distributed by McGraw that outlines the major events in the development and marketing of MACOS.³⁰⁴

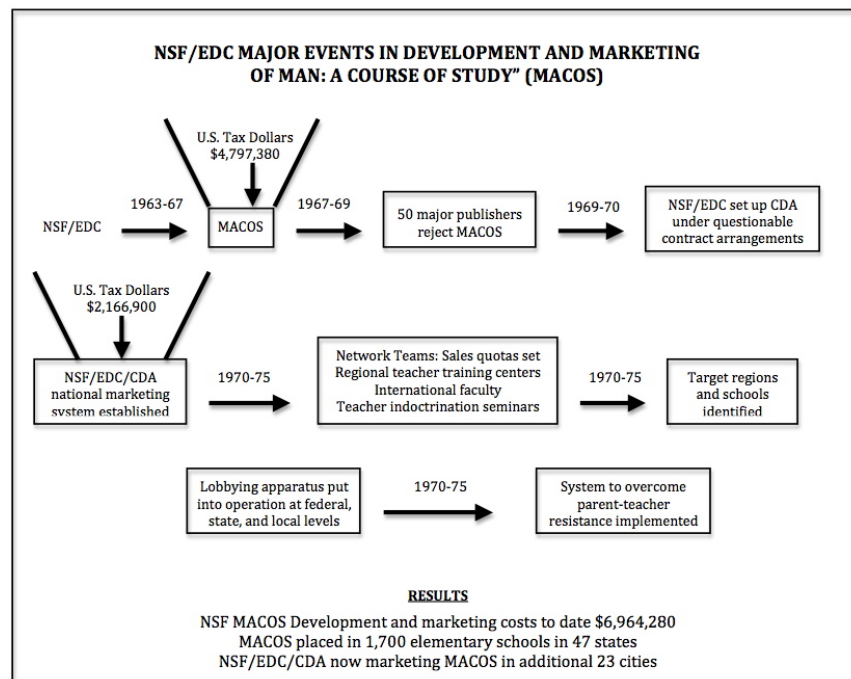


Figure 5

³⁰² Ibid., 5.

³⁰³ Ibid., 6.

³⁰⁴ Ibid., appendix.

This chart was presented with the intent of demonstrating the use of taxpayer dollars for the federal promotion and marketing of educational materials, and furthermore was paired with accusations of squelching teacher resistance to the program and bribing schools with graduate credit for teachers and lower costs to districts. Such federal involvement was presented as “unhealthy and a dangerous invasion of academic freedom and choices of taxpayers on the local level.”³⁰⁵ McGraw culminated her speech by asking Congress to stop programs such as MACOS before the federal government gained a stranglehold on local education.

Congress decided to withhold support for the dissemination of NSF curriculum materials in the upcoming fiscal year.³⁰⁶ The NSF, which had already curbed much of its funding for educational programs, responded by drastically restructuring its education directorate in the summer of 1975. In October 1975 the NSF announced that it would carry out a review and evaluation of sixteen active curriculum projects, in part a response to the “FY 1976 Congressional instruction that NSF develop a clear rationale for carrying particular projects through to an implementation phase.”³⁰⁷ The review was to be carried out by panels of scientists, educators, and representatives of the public.

This review process began with a letter distributed to project directors asking for cooperation. One such letter was sent to Peter Dow, the MACOS project editor. This letter introduced the review, and asked for the submission of all curricular materials “as soon as possible, whatever their current state of development.”³⁰⁸ To emphasize this point even further, the letter continues:

It will be necessary that the review be completed before any additional publication or printing of materials is undertaken. Therefore, I am requesting you advise us of the actions you will take to assist us in implementing the review. I am also requesting that you make contingency plans for incorporating the results of this review in your project and inform us of those.³⁰⁹

By the end of the year many existing projects were discontinued, in a decision sometimes referred to within the NSF as the “December Massacre.”³¹⁰ By the following February, the new Acting Assistant Director for Science Education, Harvey Averch, summarized his views on the role of the NSF in future curriculum activities: no new curriculum projects would be undertaken without systematic assessment; new projects would receive small awards and be subject to evaluation before more funding was allocated; large projects would be similarly reviewed regularly and subject to termination; independent evaluation procedures would be established for all projects.³¹¹

³⁰⁵ Ibid., 6.

³⁰⁶ Dow, *Schoolhouse Politics*, 231.

³⁰⁷ Jack Renirie, “NSF to Conduct Review of Curriculum Development Projects” October 31, 1975. Curriculum Development – Copies of Congress. Corresp.; Box 7; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³⁰⁸ Harvey Averch to Dr. Richard Andree, October 23, 1975, 1. Curriculum Development – Copies of Congress. Corresp.; Box 7; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³⁰⁹ Ibid., 2.

³¹⁰ James Wilson, interview.

³¹¹ Dow, *Schoolhouse Politics* 232.

Clearly, the NSF education directorate was facing imposed (and self-imposed) limitations. Despite Averch's attempts to strengthen the NSF's relationship with Congress, Conlan (and others) continued to fight aggressively against the Foundation. Averch acquiesced by once more drastically cutting funding to educational programs.

Following MACOS, the NSF would be under new pressure for accountability. Although the vast majority of the controversy that led to the NSF retreat from precollege education centered on an anthropology course, interest in funding other education reform in other scientific disciplines waned due to general reticence to get involved in the classroom and the practicality of diminished funding. This can be seen in a chart [Fig. 6] published by the National Science Foundation depicting science education funding at the agency.³¹²

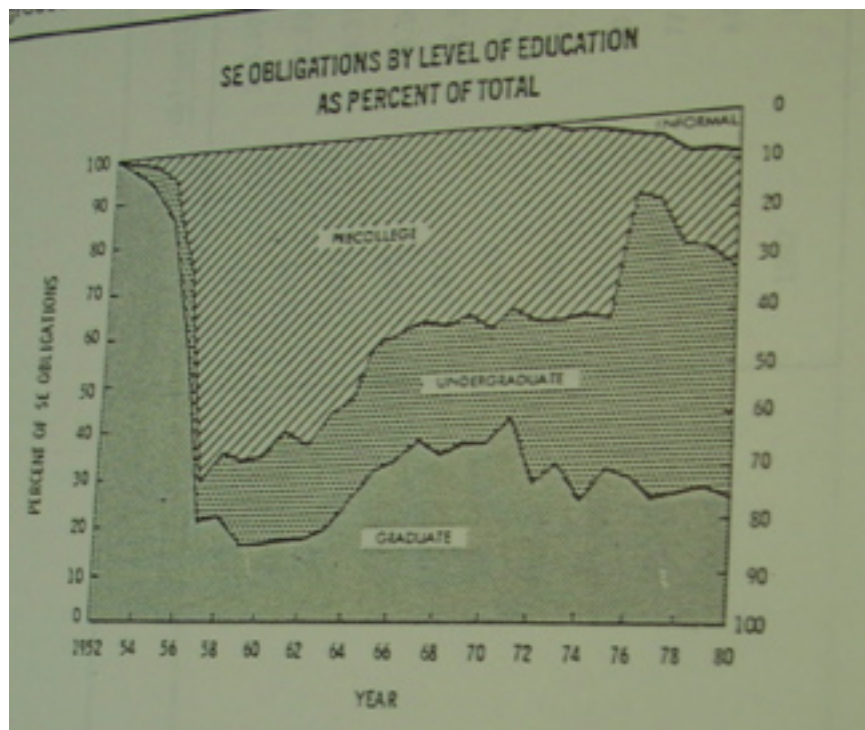


Figure 6

The overall fraction of the NSF budget set aside for science education was 46 percent in 1958, a figure that dropped to 8 percent by 1980.³¹³ The above chart indicates a far more drastic change in precollege education, with a sharp decline in funding occurring between 1975 and 1976.

³¹² "Historical Perspectives of the Science Education Program" Prepared by Office of Program Integration of NSF, September 1981, 4. Attached to Memo from John B. Slaughter to Members of the National Council on Education Research, "Science and Engineering Education," September 18, 1981. Develop. Files (1); Box 2; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³¹³ Council of Scientific Society Presidents to U.S. Dept. of Education, "Assessment of the Formation, Public Sponsors, and Mechanisms of Operation of a National Body to Promote Excellence in Education for Science and Technology—DRAFT" 400-81-0011, 12. 1st Operational File (3); Box 2; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

Yet mathematics education would prove to be an area where the NSF could pursue educational initiatives in a relatively “safe” way. Of course, mathematics was not immune to the results of the MACOS controversy and the larger cultural shift opposing heavy-handed federal intervention in the schools. In a 2000 oral history, mathematician Paul C. Rosenbloom speculated that a reduction in educational initiatives in mathematics was directly related to the MACOS controversy:

Education is very much dominated by fads, and the period of curriculum experimentation in mathematics and other subject matters lasted until about 1968, something of that sort. There was still some activity until 1972, but then for a while education was dominated by questions of race and politics, and there was very little interest in curriculum anymore. I don’t know whether this was part of it, but the division of the National Science Foundation that was active in supporting curriculum experimentation (maybe I’ve already told you this) curriculum programs in the National Science Foundation, they began getting involved in the social sciences, and they supported a project of teaching anthropology in the schools. This project of anthropologists produced a film of a seal hunt among the Eskimos, and Congress was shocked at the exhibition of cruelty to the seal pups and stuff like that that was shown in these films, and they were shocked at the idea that this was advocated as something to teach children. I think that this was a crucial event in ruining this division of the National Science Foundation. I’m not sure. But after that I heard very little more about it.³¹⁴

Despite Rosenbloom’s assertion that the Education Directorate at the NSF was ruined, in fact in the following years mathematics education would offer an important model for the Foundation’s large-scale reentry into education programming. During the MACOS controversy, at the same meeting when Onalee McGraw delivered her scathing review of the Foundation’s work in precollege education, John Conlan summarized the issue facing the NSF: “This is simply not the kind of material Congress or any federal agency should be promoting and marketing with taxpayers’ money.”³¹⁵ Conlan’s assessment indicated the dual nature of the opposition to Foundation involvement in precollege education: both the content of curricula and the level of federal involvement in classroom adoption of such curricula. Indeed, the content of the MACOS curriculum was an issue specific to that one particular project, and likely the controversy would have died down if that was the only charge brought up. Instead, however, questions about federal funding, publication, and marketing intersected broad areas of concern about the structure of the US educational system and the limits of federalism. Nevertheless, the NSF—a leader in education reform only a few years earlier—was not entirely willing to recuse itself from responsibilities to support education. In the post-MACOS era, precollege mathematics education offered both a solution to the problems the NSF encountered based on

³¹⁴ Paul C. Rosenbloom, interview with Dave L. Roberts, Toronto, November-December 2000. National Council of Teachers of Mathematics Oral History Project. Archives of the Mathematical Association of America, University of Texas at Austin.

³¹⁵ Kraus, “The Fight Over MACOS,” 309.

content—mathematics was generally assumed to be far more neutral, content-wise, than curricula that might include topics antithetical to conservative American values—and also those problems encompassing challenges to federal authority, as the mathematics education community developed a model of assessing community needs and desires, and developing a structure to maintain state and local autonomy even as “national” curricula guidelines were established.

The Post-MACOS Foundation: reassessing science and math education in the 1970s

Following MACOS the NSF began to refocus its efforts outside of the Education Directorate in a less expensive—necessary in the face of dwindling Congressional appropriations—and lower profile fashion. Almost exclusively, the agency refocused its efforts in data collection, rather than the development of course materials. In this way it continued to work in precollege education, but without tangible classroom application. Importantly, these efforts were both undertaken in reviews of mathematics education *and* mirrored by independent mathematical groups. Such efforts then converged in the 1980s, allowing mathematics education to capitalize on a stronghold of data collection on which classroom reforms could be based.

Such data collection took many forms, one of which was the follow through on the recommendation provided by both the House Subcommittee’s and the NSF’s report on MACOS that “a needs assessment program should be initiated to develop and establish priorities for curriculum development.”³¹⁶ This encompassed the very general to the specific, with data collection profiling the general public, students, educators, and scholars. Aware of the reputations applied to the Foundation as the MACOS controversy unfolded, The NSB in the late 1970s held hearings around the country to learn what states and localities desired from NSF programming. The Board also passed a resolution in June 1977 that welcomed “nonscience or public members” to its ranks in an effort to maintain greater public participation in NSF deliberations. President Carter likewise appointed more industry representatives to the Board.³¹⁷ These motions to include members of the local community both sought to combat the charges of elitism lodged at the NSF, and also provided somewhat of a safeguard against inadvertent inclusions of objectionable material or overstepping bounds between state, local, and federal. With conservatism becoming the dominant trend in American culture and politics, the NSF was careful to work within this milieu in defining future federal efforts in precollege education.

In one of the first efforts in data collection that almost immediately followed MACOS, the NSF sponsored an assessment of the status of elementary and secondary school practices in science, math, and the social sciences. In this review, three approaches were used—survey, case study, and literature review. This review was undertaken with the goal of creating an extensive information base with which to achieve a greater understanding of the strengths, weaknesses, and needs of the nation in precollege science and math education. This study, referred to as the *Status Study*, was published in six volumes in 1978.³¹⁸

³¹⁶ Merelman, Richard M. (1984) *Making Something of Ourselves: On Culture and Politics in the United States*, (Berkeley: University Press), 224-225

³¹⁷ “Steady State, Steady Strain” *The National Science Board: A History in Highlights 1950-2000*. Accessed at: <http://www.nsf.gov/nsb/documents/2000/nsb00215/nsb50/1970/macros.html>

³¹⁸ National Science Foundation and the Department of Education, “Staff Analysis.” *Science and Engineering Education for the 1980’s and Beyond*, October, 1980, 56. NSB Commission on Pre-college Education in Math, Science

The extensive data filled nearly 2,000 pages in those six volumes, and therefore was not readily accessible to the lay reader. To make this material more accessible for a broader audience—and in particular, for policymakers who would ultimately make the decision of whether NSF could reenter education programming—the Foundation invited nine organizations to independently analyze the studies and write reports on their findings. The NSF described these resultant reports as “not only descriptive, they are also normative. Each organization was asked to extract from its analysis the major needs in science education from the point of view of its membership.” In asking each group to analyze the reports in such a way, the Foundation hoped to provide a collective analysis of “what problems and issues are thought to be most important, what the system’s strengths and weaknesses are believed to be, and what the most important strategies for improvement might be.”³¹⁹ These nine reports were published in a single volume (1980) under the title *What are the Needs of Precollege Science, Mathematics and Social Science Education? Views from the Field*.

Despite the seemingly comprehensive nature of the *Status Study*, the NSF engaged in a number of other large-scale data collection initiatives. One such initiative resulted in the 1980 *Science Education Databook*, a collection of quantitative information regarding science and math education in the United States. This project was the first of its kind since 1960—or since before the NSF became involved in active course content improvement.³²⁰ The *Databook*, which prominently features two bar graphs, a pie chart, and a line graph on the cover, was a compendium of quantified data. The introduction, written by James Rutherford, explains the purpose: “While there is a good deal of information regarding *science* on the one hand, and *education* on the other, there has not been available in one place a compendium of quantitative information portraying *science education* in the United States. This Science Education Databook is intended as a step toward filling that need.”³²¹ This admission—that while NSF education programs benefitted from quality information on both science and education there was not much known about science education—was seen as a central historical problem in the NSF’s tradition of funding education reform. As the Foundation was called upon for greater accountability, it became more and more important to assess the efficacy of the curriculum projects that were funded since the 1950s. The legacy of such assessment studies done by those in mathematics education reform would serve to propel mathematics curriculum projects to the forefront of this new effort to better understand not just science and not just education, but science education.

Another important document emerging from the NSF in 1980 is a report to the President titled, *Science Education for the 1980s and Beyond*. This document, while not as strictly quantitative, compiled data concerning principal factors and trends that were predicted to impact science education. A large component of the report focused on television, other media, science museums, and other nonschool settings. This document is

+ Technol. (Development File) [1]; Box 1, Course Content – Development File; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science and Technology, 1965-1982, RG 307; NACP.

³¹⁹ Ibid.

³²⁰ National Science Foundation, *Science Education Databook* SE 80-3, 1980, iii. NSB Commiss. on Precollege Education in Math, Science + Techn., (2); Box 3; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³²¹ Ibid.

primarily important in that it bridged the gap between “neutral” data and active influence in the classroom. While the *Science Education Databook* presented data, charts, and graphs without prescriptions for improvement, *Science Education for the 1980s and Beyond* began to diagnose some of the problems and suggest avenues for improvement. This shift did not go unrecognized, as the Foundation later uses it as support for reentry into education initiatives—by 1981 the NSF is arguing that it is time to move past simply studying the problems in precollege math and science education, and instead work collaboratively with other interested parties in “grassroots effort to understand and act to rectify some of the problems we are all familiar with” [See Ch. 4].³²² Indeed, just a few years after NSF was effectively banished from work in science education, the Foundation’s adherence to strict data collection paid off. One letter to the NSB from the New York Academy of Sciences goes so far as to chastise the NSF for not taking more direct action: “I should point out, by the way, that we were generally disappointed in the above-mentioned report as being too shallow to serve as the hoped-for rallying cry for improving the state of science education in this Country.”³²³

Yet while the NSF was growing increasingly comfortable with the idea of reentering the classroom, conservative values increasingly challenged such federal involvement, with the question remaining: who, then, should make these necessary improvements to education? At first glance it might seem that the dominant conservative ethos of the time would nearly demand that the NSF and the federal government step away from precollege education, leaving such matters to states and localities. Yet this does not happen, and indeed the march toward the unprecedented level of federal involvement inherent to No Child Left Behind requires a more nuanced perspective of the conservatism of the 1970s and 1980s that impacted federal education policy.

Historian Stephen Tuck cautions against a simplistic reading of the conservatism of this era as simply emerging as a reactionary movement following the perceived excesses and failures of the 1960s. Perhaps even more important for this story, however, is the assertion that the conservatism of George W. Bush era No Child Left Behind is a direct descendent from the conservatism that arose in the 1970s and 1980s, not a different brand of it.³²⁴ How, then, can we reconcile the traditional conservative values of limited federal involvement with the reality of increasing federal investment in education—supported widely by the Right—by George W. Bush administration?

Historian Bruce Schulman defines the Bush-era conservatism as “compassionate conservatism,” and argues that it arose from the evolution of the Right that unfolded in the 1970s.³²⁵ In the 1970s—during the time when the NSF was forced to redefine its role in education—conservatives wrestled with those “trends, contests, and conflicts that have defined the public realm ever since.”³²⁶ It was during this time that the Right “coalesced

³²² Lewis M. Branscomb to Dr. Morris H. Shamos, April 5, 1982, 1. Development File (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³²³ Morris H. Shamos to Dr. Lewis H. Branscomb, March 12, 1982, 1. Development File (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³²⁴ Tuck, “Reconsidering the 1970s,” 618.

³²⁵ Bruce J. Schulman, “The Empire Strikes Back -- Conservative Responses to Progressive Social Movements in the 1970s,” *Journal of Contemporary History* 43:4 (Oct. 2008): 697.

³²⁶ Bruce J. Schulman and Julian E. Zeilitzer, eds, *Rightward Bound: Making America Conservative in the 1970s*, (Cambridge, MA: Harvard University Press, 2008) 10.

into a full-scale political movement and forged durable connections between state and society,” and redefined traditional conservative values to better suit a changing nation.³²⁷

Conservative views on federalism and education were shaped during this period. The same home televisions that led Americans to decry the slipping morals and values of the nation also served to discredit the idea of governmental decentralization. Historian Gareth Davies argues that there was a sort of “moral grandeur” to the social movements of the 1960s, and even as traditional “conservative” values were challenged, it was politically difficult to oppose such issues as racial equality, women’s rights, and education for the underserved.³²⁸ Furthermore, the perceived failure of the states to rein in race riots and other protests led many to call for a national response to local problems, which became similarly politically difficult to oppose.

Davies argues that such tensions led some conservatives in the 1970s to explicitly back away from federalism and instead formulate “a muscular conservatism just as likely to tout aggressive government action as to condemn it.”³²⁹ One area where this would occur most visibility in the ensuing decades was in education. As education lobbyists in the 1970s framed the defense of Great Society educational programs in stark “pro-education” and “anti-education” terms, even the staunchest of conservatives were reluctant to characterize themselves as the latter. During this period the conservative view of federal involvement in education evolved to increasingly accept that the federal government had the responsibility to oversee education both for national interests [See Chapter 5] but also because the states were seen as increasingly incapable—financially or otherwise—to keep order in the schools. Though state and local autonomy would be maintained at a certain level, by the 21st century the idea of federal oversight of the nation’s precollege curriculum enjoyed wide support among Republicans, culminating in the legislation of No Child Left Behind.

The NSF, as it sought to define its role in precollege education, acknowledged the tensions in federalism, but urged a strengthened federal role in the same terms of both supporting education generally and the necessity of federal intervention to counteract the limitations felt by states and localities: “The system that is called upon to fulfill these tasks is highly pluralistic and politically diffuse. It consists of approximately 17,000 individual school districts, each of which has primary control over standards, curricula, and budget allocations for faculty salary, facilities, and equipment.” Although state and local governments are stated to spend over ten times the amount of the federal government, “changing demographic and funding patterns are placing considerable stress on the system.”³³⁰

Mathematics Education and New Directions for Education at the NSF

The abovementioned examples are certainly important in the history of NSF involvement in mathematics education, yet these examples remain broadly-based, sharing focus with

³²⁷ Tuck, “Reconsidering the 1970s,” 619.

³²⁸ Davies, “Towards Big Government Conservatism,” 633.

³²⁹ Schulman, “The Empire Strikes Back,” 699.

³³⁰ “National Science Foundation and the Department of Education, “Staff Analysis.” *Science and Engineering Education for the 1980’s and Beyond*, October, 1980, 45. NSB Commission on Pre-college Education in Math, Science + Technol. (Development File) [1]; Box 1, Course Content – Development File; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science and Technology, 1965-1982, RG 307; NACP

education in the sciences. More important for this particular story, then, is the fact that the NSF continued to fund *discipline-specific* data collection, even as the agency shied away from influencing course content directly. In mathematics in particular, a discipline that historically maintained a strong interest in education research and reform, these data collection initiatives paralleled the efforts of the NSF and ultimately served to bring mathematics curricula reform to the forefront of NSF efforts in the 1980s when the Foundation reentered work in education. Throughout the 1970s the Foundation helped to fund a series of studies undertaken by the National Council of Teachers of Mathematics (NCTM) that resulted in the compilation of a significant amount of hard data. The results of these studies yielded “more information about mathematics classroom practice than we have ever had.”³³¹ Recommendations from these studies about how to best impact reform in the classroom were put forth in the 1980 report, *An Agenda for Action*, which nearly immediately was met with a warm reception [See Ch. 4].

Along with *An Agenda for Action*, which rapidly came to impact classroom instruction in mathematics, the NSF also funded another NCTM study with parallels to more general Foundation practices. This study, *Priorities in School Mathematics* (PRISM), was an extensive study of the *opinions* of many sectors of society, both lay and professional. PRISM was intended specifically to help foster “continuing usefulness” of the data collected in *An Agenda for Action*, as NCTM recognized that “[k]nowledge of current beliefs can be useful in predicting which curriculum changes might be readily adopted and which ones might meet with resistance.”³³² This can be compared to the NSF’s *Status Study*, which sought to outline existing attitudes and preferences to education reform, yet the PRISM report offered both more comprehensive and more carefully analyzed data. In short, the mathematics education community made clear the direction that future reform could go *without* fear of a MACOS-style backlash, either in terms of content or based on principles of federalism.

The PRISM report also presented mathematics education reform in terms akin to the “moral grandeur” of social movements. *All* students, the report urged, needed a solid foundation of mathematics education, with specific recommendations addressing students of all abilities, vocational aspirations, and interests.³³³ The PRISM report recommended, “a flexible curriculum with a greater range of options should be designed to accommodate the diverse needs of the student population.” It goes on to say, “Mathematics is pervasive in today’s world. Mathematical competence is vital to every individual’s meaningful and productive life. It is, moreover, a valuable societal resource...” and:

To say that most students should study more mathematics is not to say that it should be the same mathematics for all. It does not mean simply

³³¹ National Council of Teachers of Mathematics, *An Agenda for Action: Recommendations for Schools Mathematics of the 1980s*, (Reston, VA: NCTM, 1980) i. Development File (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³³² National Council of Teachers of Mathematics, *Priorities in School Mathematics: Executive Summary of the PRISM Project*, (Reston, VA: NCTM, 1981) 3. Development File (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³³³ England, “The Federal Interest in Secondary School Science and Mathematics,” 20.

keeping all students longer in the same traditional track. In fact, such a recommendation poses a tremendous challenge to curriculum developers and school districts to devise a more flexible range of options, a diversified program to meet a variety of interests, abilities, and goals.³³⁴

Greater equality in the classroom—another issue that was politically impossible to oppose—was specifically addressed: “Since a higher level of mathematical skill and understanding will increasingly become a significant advantage in nearly all lives, then justice demands that all groups have equal access to these advantages.”³³⁵ The report specifically signifies women, minority groups, and students with physical handicaps or learning disabilities as high priority—NCTM recommended the development of differential curricula to begin to “move away from the idea that everyone must learn the same mathematics and develop the same skills. Mathematics and mathematical ability cover a much broader range than most people realize.”³³⁶

The NCTM PRISM report consciously did not offer a road map for concrete changes to be made in the mathematics classroom, but instead presented highly quantified, survey-driven data intended for use in the *development* of plans for translating *An Agenda for Action* into practice. This was a data-collection initiative undertaken by the NCTM at the same time the NSF was participating in similar ventures, intended to offer a “general picture of the position of various groups as they relate to issues in mathematics education.”³³⁷ Just as the NCTM began to present its findings as applicable to practical improvements at the curricular level, the question reemerged as to who would be responsible for implementing these changes. The NSF, once an obvious answer to the question, was conspicuously absent in education reform, yet the Foundation’s work in data-collection positioned it well to partner with groups such as NCTM for making practical contributions to curriculum reform.

By the early 1980s, the NSF had—with the help of the NSB—managed to emerge more socially relevant and more equitable in its distribution of funding, yet its basic mission to support basic science was intact. At the start of a new decade, then, the NSF began to send out feelers to reenter its work in education. It was widely understood that it would be a rocky reentry, yet the NSB made its case for what was considered a crucial component of Foundation work. In front of the US House of Representatives, Lewis Branscomb, chairman of the NSB, frankly outlines his (and, it is implied, the official stance of the NSB) thoughts on the role of the federal government (and, it is implied, specifically the NSF) in effecting education reform. He claims that in the years following Sputnik, “It was the general consensus that it was an appropriate role for the Federal government to take leadership in those areas and the National Science Foundation was looked to provide that leadership.”³³⁸ Starting in the early 1970s, however, there was

³³⁴ National Council of Teachers of Mathematics, *An Agenda for Action*, 17.

³³⁵ *Ibid.*, 18.

³³⁶ *Ibid.*

³³⁷ *Ibid.*, 33.

³³⁸ John B. Slaughter, “Remarks by John B. Slaughter before the Subcommittee on Science, Research, and Technology of the U.S. House of Representatives, February 25, 1982,” undated, 4. Development File (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

much disagreement between the Administration and Congress, with funding both variable and unpredictable. Branscomb's wording is dramatic:

That give and take, that flirting between feast and famine, that excursion on the cycle between the peaks and valleys of adequacy and inadequacy has a significant and, in some ways, an irreparable effect upon the programs that were in place during those times. That experience has had an effect upon the staff of the Foundation, an effect upon the scientists doing the research in those areas and upon the science education community including those students who were the beneficiaries of the programs we had put in place.³³⁹

Branscomb thus artfully lays out the historical precedent for NSF involvement in precollege education and offers justification to reenter the field for the sake of rectifying the “irreparable effect” on students, while still acknowledging the past failures of the Foundation so as not to be open to criticism. Branscomb lays out a more specific plan for moving ahead—one that combines the continuation of staid data-collection with a careful divorce from directly promoting or marketing educational materials. In the new iteration of NSF education initiatives Branscomb proposed two useful activities: “(1) systematic monitoring efforts to identify and delineate good practice on the local level for possible use by others; and (2) generation of curriculum structure, criteria, and standards to provide a framework for publishers and/or adoption by agencies in their decision making.”³⁴⁰ Both of these criteria, importantly, were hallmarks of earlier mathematics education programs, both in terms of classroom oversight and project assessment, as well as the encouragement of outside dissemination of curricular materials for inclusion in competing texts and programs.

Branscomb's proposal ultimately manifested in the NSB Commission on Precollege Education in Mathematics, Science and Technology, described in greater detail in Chapter 4. This Commission, however, helped define the Foundation's goals and strategies for moving forward with education programs in the future, and the mathematics education community was both already well-positioned to take a leadership role and also adapted to better fit the federal goals for curriculum reform. Crucially, the new Commission, though overseen, ostensibly, by the federal government, was carefully presented as one that would be relatively hands-off. NSF Director John B. Slaughter, in describing the goals of the Commission, allowed that the broad purpose of the Commission would be to produce a “national agenda” for education. He makes explicit that, “National, in this sense, should not be interpreted as Federal.” Instead, Slaughter explains, the Commission would identify groups and organizations with a stake or interest in the nation's math and science education, the NSF maintaining what he describes as a purely “catalytic” role. In this, the Commission would act as a leader not in effecting reform per se, but rather in marshaling the resources necessary to delegate such reform efforts to groups able to

³³⁹ Ibid., 5.

³⁴⁰ “Dr. Lewis H. Branscomb Additional Questions for NSF Hearing Record,” undated, 5. 1st Operational File (3); Box 2; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

independently direct—if with the help of federal dollars—curriculum and classroom reform efforts and address problems in the nation’s math and science education.³⁴¹

Importantly, the mathematics community recognized shared interests with the Commission’s goals, and made public its support for the new NSF initiative. The Mathematical Association of America (MAA), for example, indicated even before the Commission secured House approval that the organization “supported the Commission and sees the focus at the middle school and secondary school level.”³⁴² Such vocal support likely only helped vault an already active group of math education researchers and activists to greater recognition within a Commission tasked with identifying exemplary reform efforts. In the Commission’s first meeting, on July 9th, 1982, the Educators Panel of the Commission specifically asked the Conference Board of the Mathematical Sciences (CBMS) to further explore the state of precollege mathematics education in the United States for future review by the Commission.³⁴³ The CBMS moved quickly, organizing a special conference to address what should be in the mathematics curriculum. What is important about this conference is not that it directly led to successful education reform, though such discussions did pave the way for the development of comprehensive standards for math education later in the decade [see Ch. 4]. What is important is that as the NSF once more began to tackle problems of curricular reform—or, using the language of the Commission, it sought to “develop, recommend and promulgate a set of principles, options and educational strategies” to influence math and science education in the nation—the *mathematics* education community was first recognized as a group interested, able, and *ready* to begin work on effecting reform.³⁴⁴ It was the mathematics community that was seen to be “safe” in terms of content, and well prepared in terms of understanding the needs and desires of various constituencies that would ultimately approve or discredit any curricular reform. It was the mathematics education community that offered the promise of a curriculum reform schema that would be wholly different from that of MACOS, and ultimately would provide a sophisticated model for bipartisan support of federal intervention in the classroom.

Conclusion

While the NSF began to reenter curriculum reform, in part partnered with the mathematics education community, funding for NSF education initiatives remained limited throughout much of the 1980s. For both practical, financial reasons as well as concerns about the limits of federal authority, data collection continued to be the main thrust of NSF education efforts until the end of the decade. Yet mathematics education

³⁴¹ John B. Slaughter to Bill Cosby, December 31, 1981, 2-3. Development File (2); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³⁴² Talmadge to Senior Science Associate, “Daily Progress Report #3,” December 17, 1981. Folder Development File (2); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³⁴³ Conference Board of the Mathematical Sciences, “Mathematical Sciences Curriculum K-12: What is Still Fundamental and What is Not, Preliminary Report to the National Science Board Commission on Precollege Education in Mathematics, Science, and Technology,” October 4, 1982, 3. NSB Commiss. on Precollege Education in Math, Science + Techn., (2); Box 3; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³⁴⁴ “Charter: Commission on Precollege Education in Mathematics, Science and Technology,” January, 21, 1982, 1-2. Development File (3); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

reform did not carry with it the same problems that other disciplines did. After MACOS, the NSF sought directions in which it could make an impact in education reform that would not result in anything similar to the MACOS controversy. At this time, the mathematics education community was strong, unified, and prepared to propose mature curriculum reform programs. Even as the NSF's educational initiatives virtually capsized, the math education reformers continued to work, through NCTM and other interested groups. Though these groups were not wholly dependent on federal funding during this time, the NSF—with its hands tied in science education and searching for ways to redefine its post-MACOS role in education—did use some of the limited funding it had to fund these programs.³⁴⁵ Beginning around 1985, a number of long-range projects and programs were initiated, thus reentering the NSF into larger scale research and development in mathematics education, including work in middle school number concepts, algebra, problem solving, pedagogical effectiveness, and classroom technology.³⁴⁶ The NSF, therefore, was engaged in mathematics education in various ways throughout the 1980s, from support of mathematics groups interested in pursuing reform to continued assessment of the nation's mathematics classrooms.

By the 1990s, the NSF and the mathematics education community were well-partnered in the post-MACOS milieu, but it was the release of the NCTM *Standards* [See Ch. 4] that provided the crucial model for pursuing federal educational policies that would be palatable to liberals and conservatives alike. Even as conservatives sought to distance themselves from being branded anti-education, Big Government educational programs were still politically sensitive. Nevertheless, the 1970s and 1980s ushered in a sense that education demanded a “muscular conservatism” of sorts, which would strengthen the federal oversight of the nation's schools. Of course, this was far more difficult to argue when topics such as evolution or sex education were at issue; mathematics, by contrast, was both assumed to be politically neutral (by most people, though this would slowly shift throughout the 1990s) and well-researched so as to offer appropriate pedagogy and content. What *Standards* offered was a road map of how to implement sweeping curricular changes in mathematics across the nation without butting up against any of the federalism arguments that arose during MACOS.

The time for the NSF to lay low was in the past; now, the NSF lunged full force ahead in helping to coordinate a national initiative—“as opposed to piecemeal remedial efforts” which it saw previous efforts to be—to address all components of the educational system [See Ch. 4]. This, too, was presented in a language that indicated a plan heavily supported by empirical data: systemic reform is necessary to “ameliorate the performance gap—which demographics dictate we must do.”³⁴⁷ This systemic reform had moved away from the ideals of reform in the 1960s; in the 1990s, systemic reform meant a change in infrastructure perhaps even more than a change in outcome.³⁴⁸ Ultimately, this systemic reform would foster bipartisan support of increasingly heavy-handed federal intervention, which would allow the George W. Bush agenda to pass No Child Left Behind (NCLB).

³⁴⁵ Research Advisory Committee of the NCTM, “Mathematics Education Research: 1985 in Review,” *Journal for Research in Mathematics Education* 17:4 (July 1986), 317.

³⁴⁶ *Ibid.*, 318.

³⁴⁷ National Science Foundation, *The Learning Curve: what we are discovering about U.S. science and mathematics education* (Washington, DC: NSF, 1996), 4.

³⁴⁸ *Ibid.*, 5.

The NCLB legislation, though unprecedented in terms of federal authority of the classroom, developed from the MACOS-era reassessment of federalism, and was directed by the evolving relationship between the National Science Foundation and the reform efforts of the mathematics education community. Though much scholarship on mathematics education reform seeks to document the continuity of process from the 1950s to the 21st century, when approaching the subject from the vantage point of NSF-involvement it is important to recognize the historical contingencies that influence both curricular reform and larger educational policy. Here, it is shown that the NSF's support of mathematics education hinged—in part, and perhaps unexpectedly—on the Foundation's involvement in a controversy surrounding a social sciences curriculum improvement program. After MACOS, the NSF sought directions in which it could make an impact in education reform that would not result in anything similar to the MACOS controversy. This controversy, centered around the dual issues of content and authority, created an environment in which mathematics was seen as safe, in accord with public needs and desires, and therefore (relatively) uncontroversial. It also, importantly, developed a carefully researched and marketed guideline for impacting the nation's classrooms, developed at a time when conservatism reigned. In the post-MACOS climate, mathematics education offered a convenient avenue for maintaining a federal foothold in education, and served to direct federal policies in the second half of the 20th century as new conceptions of conservatism allowed for a redefinition of federal authority in the classroom.

CHAPTER 4

ASSESSING THE NATION: Mathematics Education Reform and the March Toward National Standards of Student Achievement and Educational Assessment

By 1975, the mathematics education community had seen a rapid mobilization in the previous two decades—emerging from within its own ranks, throughout the federal government, and in society more broadly—to push forward reform efforts in the precollege mathematics curriculum. Reform efforts varied widely, recommending different emphases in content and suggesting various pedagogical techniques for instruction. Various textbooks, pamphlets, workbooks, videos, and other materials were distributed to classrooms, all different in content and style but sharing a common purpose: the attempt to reform mathematics instruction through updated content and method, all combining to form what was widely considered a monolithic “new math.”

Of course, the new math was not monolithic, yet its collectivity contributed to its functioning as a coherent and well-defined component of the curriculum reform efforts of the late 1950s and early 1960s. In much the same way, the minds behind the movement were in many respects considered to be a cohesive unit: the mathematics education community. While differences in philosophy, approach, background, and agenda were apparent at the level of the individual, when taken collectively the mathematics education community—much like the materials it produced in the new math era—functioned as coherent and well-defined body within the larger context of education policy and reform in the United States.

It was in this larger context, however, that the new math curriculum in 1975 was being fundamentally questioned. It was clear to many that while the need for reforms in content and method of precollege mathematics education remained a common purpose, the structure of these reforms needed to be reassessed and retooled. In other words, the interest in bringing a “new math” to the classroom remained (though of course it would not be called this), but it would need to adapt and take on new characteristics. The mathematics education community, too, would engage in its own reassessment at this time, ultimately maintaining a sense of coherence while adopting new characteristics in adapting to the larger, changing context of U.S. educational policy and reform.

This chapter explores the evolution of the mathematics education community between 1975 and 2000. While Chapter 2 demonstrated the coherence of the community in the new math era as fairly continuous with the community-building of the early part of the twentieth century, the period following 1975 marks something of a discontinuity. For one, the partnership with the National Science Foundation (NSF) was somewhat fractured—at least financially—following the MACOS controversy [see Ch. 3]. This marked the end of what was relatively ready and accessible funding for much of the mathematics education community’s activities in earlier years. The community was, effectively, on its own. At the same time, pressure came from within the community itself that drove change. By 1975 the mathematics education community recognized the need for greater reliance on research-based methods in creating curricula and developing assessment models, as well as the need to focus on pedagogy and classroom practice

alongside the mathematical content. The community was, effectively, in need of a facelift.

These two factors contributing to the discontinuity around 1975, however, build on the narrative begun in Chapter 2. The relationship with the NSF supported an organization of the mathematics education community that prioritized the leadership of professional mathematicians, as the Foundation structured its support around curriculum reform projects that were content- or research-based. The end of such support signaled the possibility for a shift in leadership, however, and with increasing interest in pedagogy and classroom practice it was thought that leaders for future reform efforts should emerge from the teaching community. This would in fact occur in large part with renewed action from and a newfound politicization of the National Council of Teachers of Mathematics (NCTM). The NCTM, too, offered continuity of autonomy to the mathematics education community even as the backbone earlier provided by the NSF was dissolving. Membership in the NCTM was expansive and the group functioned collectively without discord—it was a unified front, in other words, that could take the reins of the reform effort.

The shifts in leadership and direction of the mathematics education community in the last quarter of the century are often characterized as simply a reaction to the larger, changing political and societal context in which education reform is embedded. Yet this characterization renders the community as somewhat passive, on the receiving end of external influences, and without agency. This chapter explores the influence of the mathematics education community *on* this larger context, and the ways in which the coherence and autonomy of the community direct the larger narrative of education reform and policy in the United States. From this perspective, the shift toward benchmarks, standards, and assessment must be understood as the result of a continued interaction between, and reciprocal influence on, the mathematics education community and federal education policies, as both adapted to the larger political and culture context of the last quarter of the twentieth century. Beginning with the internal reassessment of the mathematics education community in the 1970s, this chapter will trace the history of the community against the political and cultural context of education reform, which shifts with the publication of several important policy documents in the 1980s. During this time the respective roles of the federal government and the mathematics education community in reform are concurrently—and mutually—redefined. At this time, too, the foundations are set for standards and assessment to become pivotal to U.S. education reform, with the mathematics education community wielding strong influence on the direction of federal policy. The chapter follows the relationship between the mathematics education community and larger structures of federal education policy through the end of the century.

New Directions and New Leadership in Mathematics Education

Though much of the literature describes the 1970s as a quiet time in mathematics education reform, professors of education James Fey and Anna Graber argue that a close look at the professional literature of that decade reveals “signs of a continuing struggle for influence. In a variety of surveys and critical reflections, sectors of the mathematics education community looked back on the intentions and achievements of the new math

movement in search of insight that would win the day for their basic points of view.”³⁴⁹ This struggle for influence was fueled by the decline of the new math movement—an era of reform that held great promise but ultimately failed in its implementation.

The new math failed to gain a lasting place in the American classroom for a number of reasons. For one, many of the projects emphasized mathematical content over pedagogy. In large part this was because “the nature of the new curriculum, with its emphasis on mathematical rigor and abstraction, was a reflection of a similar focus in collegiate mathematics at that time.”³⁵⁰ However, with increasing attention to both assessment studies and new research in educational psychology it became increasingly clear that the classroom experience was equally as important as the content. Many in the community thus felt that “the dreams of the new math era had been dashed against the rocky reality of the mathematics classroom,” in that simple changes of content or new materials could no longer be seen as a sufficient means of generating vast improvement in student learning.³⁵¹ At the same time, the tradition of looking to professional mathematicians for leadership in curriculum improvements projects was seen to be flawed; future reform efforts would require experts in the classroom experience rather than collegiate mathematics. Finally, the new math faltered as a function of poorly designed dissemination. Study after study showed that despite the high level of recognition enjoyed by the new math, it failed to reach students in the classroom. For future reforms to be successful, new avenues for dissemination would be required.

The National Advisory Committee on Mathematical Education (NACOME) report of 1975 provided much of the evidence for the growing conviction that the mathematics education reform efforts needed to be restructured [see Ch. 2]. But even before the release of the final report, the assembly of NACOME by the Conference Board of the Mathematical Sciences (CBMS) indicated an imminent reorganization of the mathematics education community. Three major figures in the development of the report, Shirley Hill, James Fey, and Jack Price, all had firm ties to the NCTM—Hill and Price would become presidents, and Fey would be central to the planning of the NCTM *Standards* project. This involvement of NCTM leadership in the NACOME project “indicated a shift in leadership from mathematicians to experts in mathematics education, and the broad perspective taken by the report (covering curriculum, instruction, evaluation, teacher education, and policy and research issues) foreshadowed the broad view of educational change that would guide the NCTM’s actions in the 1980s.”³⁵²

It is not that the NCTM was unrepresented in the new math reforms—the group, and the voices of mathematics educators more generally, contributed to the collectivity of the wider mathematics education community that guided reforms. The united front presented by this community was not developed through equal representation, however; during the new math era there were “proportionately many more mathematicians who, for one reason or another, were brought into the process of looking at school

³⁴⁹ James T. Fey and Anna O. Graebner, “From the New Math to the *Agenda for Action*,” in *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick, (Reston VA: National Council of Teachers of Mathematics, 2003), 522.

³⁵⁰ Douglas B. McLeod, “From Consensus to Controversy: The story of the NCTM *Standards*,” in *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick, (Reston VA: National Council of Teachers of Mathematics, 2003), 754-755.

³⁵¹ McLeod, “From Consensus to Controversy,” 758.

³⁵² *Ibid.*, 756.

mathematics.”³⁵³ Nevertheless, one participant in the new math reforms challenged the widely-held notion that professional mathematicians dominated the reform movement, arguing that he did not think it “fair to say that research mathematicians lorded over everything and called all the shots. I think they all engaged in a process.”³⁵⁴ Another new-math era reformer corroborated that perspective:

I think [teachers] were influential then in saying how this [reform] needed to be handled. These [curriculum improvement] teams were made up of half university professors, half teachers, but these teachers were pretty strong teachers. I think they got overruled a lot, but they still had a big impact on the way in which materials were written and set up, so it’s a little hard to strike a balance there. I would say that the university people were generally dominant, but that the high school and elementary teachers were - certainly their ideas were listened to.³⁵⁵

Certainly, then, educators were no strangers to the process of reform, yet it would require a reappraisal of approach to shift the balance of leadership away from the mathematicians. This occurred in the post-new-math reassessment of earlier reform efforts. One prominent NCTM member, Bruce Meserve, recalled the impetus for that shift, claiming, “[a]fter observing the fate of MSG it should be obvious that some shift in the balance between mathematics and pedagogy will be essential in any program that is to be widely used.”³⁵⁶ Meserve remembers that after the new math, many felt that “felt that mathematical structures were now relatively well understood and they needed to consider the pedagogy as a primary vehicle for presenting those structures in a usable curriculum. In that sense they were justified in moving the mathematicians from prime motivators into counselors.”³⁵⁷

That the NCTM moved into a leadership position within the mathematics education reform efforts of the 1980s and 1990s is not solely a function of the community’s reassessment after the new math failed to launch. The Council’s increased attention to research in mathematics education, building since the 1960s, also helped propel the NCTM to the forefront of reform efforts as this research was increasingly used to justify a new direction for reform. In 1965 the NCTM formed a Committee on Research in Mathematics Education, which in 1967 conducted a conference—in coordination with the University of Georgia and the NSF—on needed research in mathematics education.³⁵⁸ Also in 1965, the NCTM released a monograph edited by Joseph Scandura, *Research in Mathematics Education*. Following its release, the NCTM conducted a survey to determine if there would be interest in establishing a research journal. In January 1970, the *Journal for Research in Mathematics Education* was launched, positing the NCTM as a leader in the growing field of mathematics education

³⁵³ Kilpatrick, oral history, 68-69.

³⁵⁴ Ibid., 35-36.

³⁵⁵ Kilpatrick and Wilson, oral history, 35-36.

³⁵⁶ Meserve, oral history, 59-60.

³⁵⁷ Ibid., 59.

³⁵⁸ James D. Gates, “Perspective on the Recent History of the National Council of Teachers of Mathematics,” in *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick, (Reston VA: National Council of Teachers of Mathematics, 2003), 745.

research, a field that would have increasing relevance to reform efforts in the ensuing years.³⁵⁹

Merely participating alongside mathematicians in the new math movement and advocating the importance of educational research, however, would not alone vault the NCTM to a position of greater influence. For this to happen, the Council would need to take a decidedly more proactive stance on reform, which it decidedly lacked during the new math era (though it did play a supportive role in such activities as publications and regional conferences aimed at acquainting the school populations with curriculum reform efforts). In their combined oral history, new math era reformers Jeremy Kilpatrick and James Wilson recalled the Council's lack of leadership in the reform movement:

Roberts: How would you characterize the role of the NCTM during the New Math era?

Kilpatrick: I'd call it largely catch up. I don't really think – I think they were playing follow up. I don't think they were out in front, certainly not to the extent they are today. I think they tried to have conferences. They tried to have publications; their yearbooks were, I think, influential, but they themselves were not really geared up to do anything more than really provide a forum for people like Begle and Kline and Beberman and Davis and others to say things. But, I don't think they – they weren't proactive, to put it another way.

Wilson: Yeah, I think even more, I'd make a stronger case. I think that the NCTM, in those days, from '58 – '68, basically, were hands off in terms of the New Mathematics. To remain above the fray and, gee, it was much later that they even agreed at NCTM headquarters to have a liaison with the government agencies and have some sort of proactive stance on influencing things happening right there under their nose. I think in the 1950-60 era that it was we were above all of that. You could go back, I think you could go back to some of the presidential statements that were made; Frank Allen's being a case in point, that this is not NCTM's business, and Frank was on the advisory board for SMSG, by the way.³⁶⁰

During the new math era the NCTM remained a forum for discussion and debate, not an arena for advocacy and action.³⁶¹ This changed in the 1970s, however, as the new math reforms were increasingly questioned and the mathematics education community looked for new directions to guide future reform efforts. The NCTM began at this time to prepare a more proactive role in reform, fueled in part by the growing recognition that future reforms would require greater input from the education and educational research communities, as well as the understanding within the NCTM it could no longer “stand off

³⁵⁹ Ibid., 745.

³⁶⁰ Kilpatrick James Wilson, oral history, 55-56.

³⁶¹ McLeod, “From Consensus to Controversy,” 759.

on the sidelines” of advocacy in the context of the back to basics curricula entering the classroom.³⁶²

By the late 1970s, the mathematics education reform discussion had decidedly shifted toward a more education-centered approach, and the NCTM was becoming both more vocal and more political. Under president John Egsgard (1976-1978), the NCTM Board of Directors agreed to make curriculum reform its top priority.³⁶³ Shirley Hill, who succeeded Egsgard in 1978, strengthened the Council’s commitment to reform, considering a major benefit to membership in the NCTM as having a collective voice that represented mathematics education, and one that could influence educational policy decisions.³⁶⁴ At the time Hill assumed the presidency, the federal government was making commitments to reading; Hill thought mathematics should be able to receive the same treatment. Her interest in working with policymakers was reflected in the hiring of Richard Long, a lobbyist who had previously worked for the International Reading Association, to represent the NCTM.³⁶⁵ Though not everyone at the NCTM agreed with this new direction for the Council, such actions did mark the start of a new relationship with reform efforts and educational policy at the NCTM:

Wilson: I was on the Board of Directors for NCTM at the time that the hiring of a government liaison was debated within the Board. Shirley Hill was the president when that was brought in, and it was not a comfortable position for the Board to take, for NCTM as a statement of policy to get into this arena. There were a number of people that were in leadership roles in the council at that time that supported it and it was the start of the transition of the role of NCTM from being reactive to proactive.³⁶⁶

By the late 1970s the mathematics education community seemed to have reorganized to address the pressing problems it saw in the education reform efforts of the new math era: content, method, and dissemination. The redefined NCTM was a comfortable fit in terms of content because it advocated the presentation of modern mathematics and mathematical understanding—concerns of the professional mathematicians—but also it stressed applications, which appeased those who criticized the new math curricula for being too abstract. NCTM also fit well with the mathematics education community’s renewed interest in including research in mathematics education and attention to the classroom experience in reform efforts. Most important of all, however, was the NCTM’s role in the problem of dissemination—of getting a reformed curriculum to the schools. By the late 1970s steps were already being taken to position the Council politically—the hiring of a lobbyist was just the first step in many that the NCTM took to strengthen its political clout and relationship to the federal structures that would ultimately provide the necessary partnerships for effecting widespread change that were not available to the new math era reformers.

The shifting balance between mathematicians and educators represents the underlying coherence and flexibility of the mathematics education community; in the

³⁶² Kilpatrick, oral history, 57.

³⁶³ McLeod, “From Consensus to Controversy,” 761.

³⁶⁴ *Ibid.*, 759.

³⁶⁵ *Ibid.*, 760.

³⁶⁶ Kilpatrick and Wilson, oral history, 57.

face of external challenges, the community looked within its ranks to reassess past action and look toward the future. The change of leadership reflected far more than a reaction to outside forces, but rather an evolving vision for reform within the community as well. The relative ease with which the mathematics education community was able to adapt to internal and external forces of change, as well as its functional autonomy in a time of few resources for reform, ultimately allowed the mathematics education community to influence larger patterns of reform in the United States.

Setting the Agenda for Action

In the wake of the MACOS scandal, and with distrust of federal involvement in education rapidly increasing, funding for curriculum materials declined sharply at the National Science Foundation (NSF). In 1975, Congress decided to withhold support for the dissemination of NSF curriculum materials in the upcoming fiscal year; the NSF, which had already curbed much of its funding for educational programs, responded by drastically restructuring its education directorate in the summer of 1975.³⁶⁷ The following February it was announced by the NSF that no new curriculum projects would be undertaken without systematic assessment; new projects would receive small awards and be subject to evaluation before more funding was allocated; large projects would be similarly reviewed regularly and subject to termination; independent evaluation procedures would be established for all projects.³⁶⁸

While the NSF did not halt all funding for education, the manner in which the funding was distributed radically changed. Immediately following the launch of Sputnik, the NSF's interests in education focused primarily on precollege programs, which used about 70 percent of all allocated funding for science education [Fig. 1].³⁶⁹ By the mid-1960s precollege education allocations declined to about 50 percent of the total science education funding, and maintained about 40 percent from the late 1960s until 1975. At this time, following the MACOS scandal, science education priorities markedly shifted from a heavy focus on precollege education to a primary focus on undergraduate education. Figure 7 shows a sharp spike at 1975, indicating the increased funding directed to undergraduate education and the corresponding dramatic decrease in funding for precollege education, which by 1976 accounted for just over 10 percent of total science education funding.

³⁶⁷ Peter Dow, *Schoolhouse Politics: Lessons from the Sputnik Era* (Cambridge: Harvard University, 1991), 231.

³⁶⁸ *Ibid.*, 232.

³⁶⁹ NSF Office of Program Integration, "Historical Perspective on Science Education Programs," memo, September 8, 1981, 4. Develop. Files (1); Box 2; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

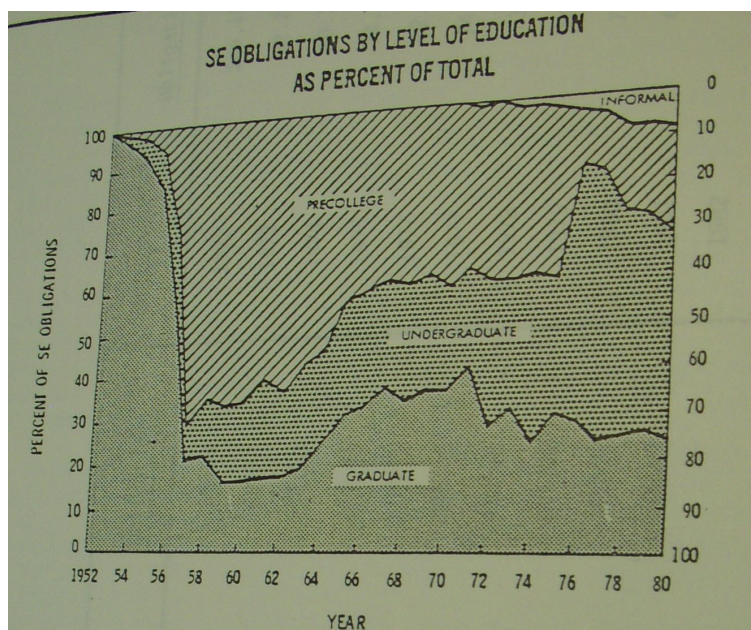


Figure 7

Much of the remaining funding in precollege education went toward existing programs that were in final stages and would be phased out. Primarily, however, the NSF began to refocus its (continued but limited) education efforts on new research programs focused on amassing of large amounts of data. Though a departure from earlier education programs, the NSF's adherence to the principle of careful data was foundational to its organizational aims and approached this as the "continuous, progressive refinement of exacting techniques of data collection and interpretation." Although some saw this as an "excess of caution" it became a cornerstone of the NSF's legacy, from its reprinted charts and graphs to its published "fact books."³⁷⁰ Ultimately, it was this data that would help support a growing trend of standardization in the classroom, as well as help develop a lasting partnership with the mathematics education community.

Following the MACOS controversy, the "NSF saw the need to determine baseline information on science and mathematics education so that the impact of NSF projects could be ascertained."³⁷¹ As a result the NSF funded three projects in the late 1970s: a national survey of teachers and their practices, a set of case studies of instruction in math and science, and the NCTM's Priorities in School Mathematics (PRISM) project, touched upon in Chapter 3. PRISM, carried out by Ohio University under Alan Osborne, took on the task of distinguishing between what was already a part of the curriculum and what *should* be a part of the curriculum, based on extensive surveys of the priorities of various interested parties.³⁷² PRISM was an attempt to "seek input prior to making recommendations [on school mathematics]. Such input was sought in response to charges that the new math failed to achieve wider implementation partially as a result of its top-

³⁷⁰ J. Merton England, *A Patron for Pure Science: The National Science Foundation's Formative Years, 1945-57*, NSF 82-24. (Washington DC: NSF, 1982), 253-254.

³⁷¹ McLeod, "From Consensus to Controversy," 757.

³⁷² Gates, "Perspective on the Recent History of the National Council of Teachers of Mathematics," 741.

down, insular approach.” Though it is not clear that this characterization is accurate, at the time the mathematics education community “took the charges seriously.”³⁷³

The data collection methodology employed in the PRISM survey was sophisticated, utilizing social science techniques of collection and analysis. One component of the PRISM survey focused on assessing priorities for curriculum change or for addressing problems in precollege mathematics education. In this section, participants were asked to rate the relative importance of various classroom alternatives and identifying areas where reform was most needed. For some of the items covered, the participants in the professional groups were asked to further explain the reasons items were ranked in a particular order. In this section, professional participants were asked to answer questions about ninety-two areas, and lay groups were asked to answer questions about eighty-four items. Both groups were also asked fifteen demographic and introductory questions. The summary report for PRISM offers a representative question from this section as an example [Fig. 8].³⁷⁴

In the 1980s there will be a limited amount of money that can be spent for the development of new materials in the areas listed below. Please indicate the order in which you think the money should be spent by marking the answer sheets in the following way:

- a = highest priority
- b = second highest priority
- c = middle-level priority
- d = second lowest priority
- e = lowest priority

Be sure to use each letter *only once* for the next five items.

1. Whole number computation
2. Problem solving in mathematics
3. Measurement
4. Fractions (concepts and computation)
5. Decimals (concepts and computation)
6. Consider the content area above that you ranked *highest* (marked with an “a”). Of the following five ideas, which best describes the reason you gave it highest priority?
 - a = We have fewer good materials to choose from in this area than in the other four areas.
 - b = This is a major problem area for many, many teachers.
 - c = It is absolutely crucial that all students develop skills in this area.
 - d = New ideas have been developed in this area that are not reflected in present materials.
 - e = The importance of this area will increase during the 1980s

Figure 8

As is evidenced by the detailed nature of the representative questions in Figure 8, the PRISM project generated a massive amount of data that the mathematics education community was able to mine as it sought new directions for reform.

³⁷³ Fey and Graebner, “From the New Math to the *Agenda for Action*,” 552.

³⁷⁴ National Council of Teachers of Mathematics, *Priorities in School Mathematics: Executive Summary of the PRISM Project* (Reston, VA: NCTM, 1991), 4-5. Development File (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

PRISM was in fact just one component of a larger project in education reform undertaken at the NCTM in the late 1970s: the development of basic guidelines for the precollege mathematics curriculum. The data collected from PRISM, combined with two mathematics assessments conducted by the National Assessment of Educational Progress [discussed below] served to inform the development of just this guideline, released at the annual meeting of the NCTM in April 1980 under the title *An Agenda for Action*. The *Agenda* offered recommendations for the direction of precollege mathematics education, and stated to “represent both realism and responsibility. They are realistic in their attention to hard data. We are fortunate to have more information about mathematics classroom practice than we have ever had.”³⁷⁵ The recommendations in *Agenda* were notably not just about content, but offered a system for complete integration of a new curriculum into the educational system—dissemination, after all, was understood to be a key component of successful curricular reform.

At the 1980 meeting, Shirley Hill described the issues facing mathematics education and the *Agenda*, and the eight recommendations for improvement.³⁷⁶

1. Problem solving be the focus of school mathematics in the 1980s
2. Basic skills in mathematics be defined to encompass more than computational facility
3. Mathematics programs take full advantage of the power of calculators and computers at all grade levels
4. Stringent standards of both effectiveness and efficiency be applied to the teaching of mathematics
5. The success of mathematics programs and student learning be evaluated by a wider range of measures than conventional testing
6. More mathematics study be required for all students and a flexible curriculum with a greater range of options be designed to accommodate the diverse needs of the student population
7. Mathematics teachers demand of themselves and their colleagues a high level of professionalism
8. Public support for mathematics instruction be raised to a level commensurate with the importance of mathematical understanding to individuals and society.

It is clear that the recommendations for action set forth in the *Agenda* address the concerns of content, method, and dissemination. Recommendation 1 and 2 both set the course for future emphasis and also carefully aligned it to the back-to-basics curriculum that many at that time were still demanding. Along with the prioritization of problem solving, recommendation 1 suggested changes in curricular content such as decreased emphasis on isolated drill and pencil-and-paper calculations, and increased emphasis on such topics as “collecting, organizing, and interpreting data; and on using maps, sketches,

³⁷⁵ National Council of Teachers of Mathematics, *An Agenda For Action: Recommendations for School Mathematics of the 1980s* (Reston, VA: NCTM, 1980), i. Development File (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³⁷⁶ National Council of Teachers of Mathematics, *An Agenda for Action: Recommendations for School Mathematics of the 1980s*,” (Washington, DC: NCTM, 1980); accessed at <http://www.nctm.org/standards/content.aspx?id=17278>.

and diagrams as aids to understanding problems.”³⁷⁷ Though this was a sharp departure from the back to basics curriculum, the mention of basic skills as a content item in recommendation 2 preempted charges that the *Agenda*’s recommendations invited a return to the “abstractness” of the new math. Nevertheless, the first recommendation emphasized the NCTM’s commitment to developing fundamental mathematical understanding in students; in this balance, the united front of the mathematics education community was deftly preserved. Method and pedagogy, too, were addressed in the report under recommendation 7—which called for coordination among educators in standard practice and professional development—and in recommendation 5, which stressed the importance of understanding the learning process, as determination of curriculum topics and sequence would be fruitless without understanding how learners approached these topics.³⁷⁸ Dissemination is addressed through recommendation 8, urging the mathematics education community to take an active role in engaging the public in the need for reform—changing the curriculum, it was understood, could only happen through a shared consensus among the mathematics education community *and* a consensus within the larger context.

The recommendations set forth in *Agenda for Action* offered even more for the vision of mathematics education reform. Recommendations 4 and 5 set the stage for the emphasis on both standards and test-based assessment, both of which would structure not only reform in mathematics, but would also come to influence education policy more generally in the 1980s and 1990s. By the release of the *Agenda*, standardized testing was already well-entrenched in the educational system but there was growing concern that the back-to-basics era testing, with its emphasis on measuring basic skills, failed to provide adequate assessments of either programs or student learning. The NCTM instead recommended more “meaningful evaluation” be achieved:

Evaluation is not limited to testing. It includes gathering data and interpreting the data. Testing is one source of data. There are many others. Today, many people use test scores as the sole index of the quality of mathematics programs or of the success of student achievement. Test scores alone should not be considered synonymous with achievement or program quality. A serious danger to the education of our youth is the increasing tendency on the part of the public to assume that the sole objective of schooling is a high test score. This is often assumed without the critical knowledge of what is being tested or whether test items fit desired goals.³⁷⁹

Assessment, the *Agenda* argued, should include “the full range of the program’s goals, including skills, problem solving, and problem-solving processes.” Problem-solving skills were further emphasized with the recommendation that “problem-solving skills should be assessed for each student over the entire K-12 school mathematics program,”

³⁷⁷ Fey and Graebner, “From the New Math to the *Agenda for Action*,” 553.

³⁷⁸ National Council of Teachers of Mathematics, *An Agenda For Action: Recommendations for School Mathematics of the 1980s* (Reston, VA: NCTM, 1980), 11. Development File (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³⁷⁹ *Ibid.*, 13.

and “[t]est designers should give attention to the need for more options in format than the conventional multiple-choice format. An emphasis on problem solving demands more flexibility and creativity in assessment than is possible within the restrictions of most current test formats.”³⁸⁰ The report also stressed that the very nature of the development of problem-solving skills required longitudinal study rather than be assessed through short-term measures, as the latter “may force a hasty and superficial treatment of programs whose objectives must be complex, interrelated, and of a long-lasting character.”³⁸¹

Improving evaluation, however, was not suggested to occur alone. Instead, the first purpose of such evaluation was stated in *Agenda for Action* to be the improvement of learning programs, teaching, and materials—in short, reform of evaluative methods would go hand-in-hand with continued reform of curricular materials. Too often, as it was stated in *Agenda for Action*, tests dictated the curriculum or the assumptions set forth in evaluation strategies were inconsistent with curricular goals. *Agenda for Action* argued that the curriculum should come first, with classroom content dictating “the nature of the evaluations needed to assess program effectiveness, student learning, teacher performance, or the quality of materials.”³⁸²

Recommendation 5 of *An Agenda for Action* would help guide the mathematics education community to lead the shift toward increased use of standardized testing in federal education policy. But this recommendation also went hand in hand with recommendation 4: the establishment of standards. The purpose of testing, after all, was to measure student learning and assess instructional efficacy, which demanded articulation of what, exactly, the goals of learning and instruction were; standardized tests measured just that: standards. As assessment programs became increasingly national in scale, the standards too became increasingly national. Over the course of the 1980s, the mathematics education community, led by the NCTM, would further develop these recommendations—*Agenda* was primarily loose framework and more specificity was needed if it would translate into reform at the classroom level—and provide the model for the federal march toward educational standards in the 1990s.³⁸³

The NSF after *Agenda for Action*

Agenda for Action did not provide specific suggestions for the oversight of reform, though it did recommend that “[f]unding agencies should support research and evaluation of the effects of a problem-solving emphasis in the mathematics curriculum.”³⁸⁴ One such funding agency was, by implication, the National Science Foundation, which by the release of the *Agenda* was newly reauthorized in its mission to support the nation’s math and science education following the 1979 establishment of the Department of Education. The establishment of the Department of Education had distinct impact on the educational initiatives of the NSF in that the new Department formalized a division of responsibility

³⁸⁰ Ibid., 14-15.

³⁸¹ Ibid., 15-16.

³⁸² Ibid., 14.

³⁸³ McLeod, “From Consensus to Controversy: The story of the NCTM Standards,” 762.

³⁸⁴ National Council of Teachers of Mathematics, *An Agenda For Action: Recommendations for School Mathematics of the 1980s* (Reston, VA: NCTM, 1980), 16. Development File (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

between itself and the NSF.³⁸⁵ Established within the Department of Education was, by original Public Law 96-88, an Office of Elementary and Secondary Education.³⁸⁶ While this office would oversee much of the nation's precollege education, the law read that this office—or any Department of Education office—should in no way “repeal or limit the authority of the National Science Foundation or the Director of the National Science Foundation to initiate and conduct programs under the National Science Foundation Act of 1950.”³⁸⁷ Included in the Department of Education Organization Act was the statement, too, that “the conduct of basic and applied research and development applied to science learning at all educational levels and the dissemination of results concerning such research and development” remain under the purview of the NSF, rather than be transferred to the Department of Education.³⁸⁸

Nevertheless, the forecast for any federal involvement in education was grim. Though the newly formed Department of Education reasserted the federal government's role in education, the Department itself—already unpopular when signed into existence—was nearly immediately threatened with the election of Ronald Reagan. During and immediately after the election, Reagan made clear that he planned to dismantle the Department outright, although ultimately he did not have enough political support to do so. Nevertheless, this was a wake-up call to a “too comfortable community of school supporters who assumed a perpetual political commitment to public education.” Reagan's distaste for the Department came as part and parcel of his disapproval of excess federal intervention, excess federal spending, and his general opinion that one could not believe that past scientific successes—understanding the atom, reaching the moon, development of computer, and ending disease, to name a few—could have happened in spite of these scientists' education: “Someone in those old-fashioned schools so despised by today's elitists must have done something right.”

As economic concerns became more pressing in the early years of his presidency, Reagan took the opportunity to slash the federal budgets for social issues he opposed, with education being one of them. Reagan originally proposed cutting education funding by 25 percent, but political wrangling led to the budget ultimately only being cut by 10 percent—still a significant amount but not as devastating as many feared. Nevertheless, leaders at the NSF recognized the potential damage such federal divestment could have on education programs at the Foundation. In 1980, the budget for science education was already reduced to just over seven percent of the total NSF budget; the Reagan administration's proposed budget cuts threatened to entirely eliminate science education by fiscal year 1983, “thereby changing the mission of this agency from its dual purposes of strengthening scientific research and science education to just research.” When this budget proposal was announced in March 1981, the National Science Board (NSB) saw “a crisis coming of serious proportion in precollege math and science education” and, while acknowledging the primary role of state and local jurisdictions in

³⁸⁵ National Science Foundation and Department of Energy, “Staff Analysis from *Science and Engineering Education for the 1980s and Beyond*, October 1980,” undated, 22. Development File (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³⁸⁶ The *Department of Education Organization Act*, 1979, Pub. L. No. 96-88, 96th Congress, (October 17, 1979), 674. Accessed at: <http://federaleducationpolicy.wordpress.com/2011/04/15/departments-of-education-organization-act-1979/>.

³⁸⁷ *Ibid.*, 680.

³⁸⁸ *Ibid.*

education, the NSB stated its conviction that “the Foundation has an indispensable catalytic role it should not abrogate, even if the level of investments is severely curtailed.”³⁸⁹ The NCTM agreed; in 1981 the Council released a report in response to Reagan’s budget cuts outlined the problems with math education and argued that the federal government needed to take a stronger position.³⁹⁰ Although there were no immediate effects of the document, this was clear indication of both the NCTM’s politicization and the mutual interests shared between the two groups.

Despite refusing to abrogate its indispensable catalytic role in education reform, the NSF carefully defined its responsibility at this time to be different than that of earlier decades, due in part, no doubt, to the delicate nature of the NSF’s reentry into education following the MACOS scandal. When later questioned by the Senate Subcommittee on Science and Space about continued efforts in education reform despite the dwindling budgets of the Reagan administration, NSB chairman Lewis Branscomb outlined the cautious nature of the Foundation’s involvement in education in the early 1980s. Though asserting that the curriculum improvement projects beginning in the 1950s “made some very important contributions to effective teaching,” Branscomb allowed that “there were some disappointments.” He noted that earlier efforts were appropriate for the economic, political, and cultural context, but that context had changed by the 1980s and therefore so too must the Foundation’s efforts in curriculum development. Branscomb admitted that the education activities of the NSF “had been declining for many years. It had become quite controversial. It was fragmented into 27 line item pieces. We did need a fresh start.” This situation, he maintained, rendered the NSF’s role in education as a “politically unviable situation” in itself, and therefore blame could not be placed solely on the Reagan administration that simply inherited the problem. Rather than point fingers, Branscomb urged, the time had come by the early 1980s to mobilize the “constructive tension” between the NSF and the Administration and rebuild the science education program.³⁹¹

Mobilizing this tension began in June 1980—on the heels of *Agenda for Action*—with a yearlong study. Upon reviewing the results of this study, the NSB determined that NSF science education activities must “focus on achievable goals with the resources necessary to attain them.” In August 1981 the NSB moved ahead with these plans and issued a policy statement on science education that proposed the establishment of a Special Commission that would oversee NSF intervention “in selected areas where significant improvement in educational outcome is possible with limited investment.” This Commission on Precollege Education in Mathematics and Science was formally approved by the NSB in November 1981.³⁹²

³⁸⁹ “Edited Excerpts from the Testimony of Dr. Lewis M. Branscomb, Chairman, National Science Board, Before the Subcommittee on Science Education, Research, and Technology, House Committee on Science and Technology, February 25, 1983,” 4-5. NSB Commiss. on Precollege Education – Highlights – Followup History (Membership Subfile); Box 4; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³⁹⁰ McLeod, “From Consensus to Controversy,” 762.

³⁹¹ “Edited Excerpts from the Testimony of Dr. Lewis M. Branscomb, Chairman, National Science Board, Before the Subcommittee on Science Education, Research, and Technology, House Committee on Science and Technology, February 25, 1983,” 4-5.

³⁹² John B. Slaughter to Members of the National Science Board, memo, “Proposed Plan for Special Commission on Science and Engineering Education,” January 8, 1982, 1. Development File (3); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

The NSB Commission was established to oversee the “(1) systematic monitoring efforts to identify and delineate good practice on the local level for possible use by others; and (2) generation of curriculum structure, criteria, and standards to provide a framework for publishers and/or adoption by agencies in their decision making.”³⁹³ It would build upon the storehouse of data already collected by the NSF to provide recommendations for reform that others could adopt into practice, develop a federal framework for curriculum structure and criteria, and define educational standards. This structure was undoubtedly similar to the model put forth in *An Agenda for Action*, though no specific reference to its influence remains in the records of the NSB Commission’s establishment.

The NSB Commission goals shared other similarities with those outlined in *An Agenda for Action*. For one, plans were set to review the present understanding of the quality of math and science education and identifying deficiencies in knowledge, ultimately outlining the actions needed to be undertaken by various constituencies in improving the nation’s math and science education, beginning at the level of the local school system.³⁹⁴ Also, the NSB Commission emphasized the importance of the public attitude on effecting reform. To this end it was agreed that increasing the national visibility of the Commission was crucial. It was decided this could be accomplished by including “prominent laypeople”³⁹⁵ along with technical professionals in assembling a group that would “attract the interest and confidence of state and local decision makers, educators, planners, and others concerned with the quality of education...[and] present a stature appropriate to a group that will deliberate and present sweeping recommendations for national policy.”³⁹⁶ Reforming the nation’s schools, apparently, would start—if not with a lobbyist—with a public relations campaign.

In a letter to Bill Cosby in December 1981—additional letters were sent to other high-profile individuals, such as Walter Cronkite and Tom Brokaw, along with more “traditional” invitees in mathematics and education—outlined the goals of the NSB Committee. NSF Director John Slaughter opens his invitation letter with a warning that NSF science education programming was slated to essentially dwindle to nothing “as a result of differences of philosophy that have risen between legislative and executive branches of the government over the past 7 or 8 years.” Slaughter affirmed that it is his belief that the Foundation be concerned with this situation, and it was this concern that led to his proposal for a Commission that would develop “a national agenda for science education for the 1980’s.” This Commission, though not presented as the leader in

³⁹³ Untitled, 5. Attachment to Harrison H. Schmitt to Dr. Lewis H. Branscomb, “Dr. Lewis H. Branscomb Additional Questions for NSF Hearing Record,” undated. Folder 1st Operational File (3); Box 2 Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³⁹⁴ D. Langenberg, “Draft, National Science Board Special Commission on Quality on Science and Engineering Education,” September 10, 1981. Development File (3); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³⁹⁵ Margaret L. Windus to Members of the National Science Board, “Commission on Precollege Education in Mathematics, Science, and Technology,” memorandum, January 22, 1982, 3. Development File (2); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³⁹⁶ Lewis Branscomb to Honorable Charles L. Wick, February 24, 1982, 2. Development File (1); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

effecting direct change, was offered instead as a “key player in helping to marshal the necessary resources to address the problems.”³⁹⁷ Invitation letters were thus sent out to potential members of the Commission and a draft charter was officially approved by the NSB at its January 21-22, 1982 meeting.³⁹⁸ The NSF had reentered science education in a fairly large way, despite budget problems and “constructive tension” with the administration.

It did so with a strong influence from the mathematics education community. As the Foundation moved to restructure its efforts in education, both *An Agenda for Action* and the final PRISM report (1981) served to arm it with detailed recommendations from the NCTM for how to reform mathematics education for the 1980s, but also with detailed data on the likely response to such reforms from many segments of the population. There simply was not comparable data in other disciplines—nor was there the wealth of longitudinal data that had been collected since the 1960s or comparable continuity through all grades K-12—all of which consequently vaulted precollege mathematics to a place of prominence in NSF efforts. The reliance on sophisticated data and the attention to opinions and demands from all sectors would characterize the work of the NSB Commission and other curriculum improvement projects in the 1980s. By the end of the decade, the shared interests between the NSF and the mathematics education community would be solidified in tradition and practice.

The sheer volume of available data about the state of mathematics education in the nation’s schools—in part, though certainly not exclusively, available through the NCTM’s *Agenda for Action* and the recent PRISM report—made a quick assessment of the state of precollege education arguably simpler than that of other fields. And quick that assessment needed to be; at the first meeting of the Commission Branscomb directed members to their first task:

People have questioned whether or not this is just another study commission—I have heard that phrase over and over again. Well, I have a surprise for you. It *is* a study commission. You have an important study to undertake. You must evaluate whether or not there is a science and mathematics education problem in our schools as a precursor to putting into action some efforts to fix the problem. I give you until tomorrow afternoon at 5 o’clock to complete that study! Richard Nicholson, Executive Director of the Commission, tells me that he hopes the problem definition phase will be completed at the end of this meeting. I also hope that can be accomplished.³⁹⁹

³⁹⁷ John B. Slaughter to Dr. William H. Cosby, December 31, 1981, 2-3. Development File (2); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³⁹⁸ Margaret L. Windus to Members of the National Science Board, “Commission on Precollege Education in Mathematics, Science, and Technology,” memorandum, January 22, 1982, 1. Development File (2); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

³⁹⁹ “Remarks of Dr. Lewis M. Branscomb, Chairman, National Science Board at the first meeting of the NSB Commission on Precollege Education in Mathematics, Science and Technology, June 9, 1982,” undated, 5. Development File (2); Box 2; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

With little over two working days to determine whether there was an education problem in the schools, and furthermore what that problem was, NSB Commission members would naturally gravitate to the most comprehensive storehouses of data, which were in mathematics education. Further directing attention to mathematics was the fact that of the three “distinguished scholars” invited to discuss the state of precollege education at this meeting, two spoke solely about mathematics. The first, James Fey of the NCTM, encouraged members to consider the problem of the depth of material in high school mathematics courses and how this material is presented, rather than simply focusing on courses offered. The second scholar, Henry Pollack, also of NCTM, argued that members should consider updating the curriculum to address the problem of teaching applications in mathematics for use in everyday life and other disciplines.⁴⁰⁰ (These two recommendations would remain a cornerstone of the principles and standards released at the end of the decade by the NCTM). In this meeting, too, during the question and answer period, the group was reminded that “the amount of mathematics known since 1940 has probably multiplied by a factor of 20,” with the implication being that curriculum reform had not kept up with these developments.⁴⁰¹ Furthermore, it was stated that there was a perception among the general public that only the most able and driven students needed to study mathematics and for the rest of students, “minimal is adequate.” It was stated, “this perception is tragic.”⁴⁰²

Mathematics education was thus situated as a convenient entryway to addressing the problems of the nation’s educational system. Not only was there ample data available to assess the state of the mathematics curriculum, but also the NSB seemed wholly behind a focus in mathematics. In an April 1982 meeting of the House Committee on Appropriations, when the Committee was formally announced, the driving factors leading to the establishment of the Commission were outlined with the testimony stating that leaders at the NSB were concerned that “the capability of school systems nationwide to offer young people the opportunity they should have, particularly to study mathematics as a pre-condition for a technical career, was declining even as the National Science Foundation was working on the problem [emphasis mine].”⁴⁰³ Furthermore, a Commission report from June emphasizes some of the problems specifically in mathematics education, including the assertion that the “back to basics” movement had “emphasized mastery of computational skills at the expense of genuine understanding” and led to a decrease of math requirements for high school graduation and college entry. “Although that trend shows some signs of reversing,” the report stated, “at present only about one-third of the Nation’s 17,000 school districts require more than one year of high

⁴⁰⁰ National Science Board Commission on Precollege Education in Mathematics, Science and Technology, Meeting Notes – Meeting of July 9-10, 1982, 3. Develop. File (2); Box 2; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴⁰¹ National Science Board Commission on Precollege Education in Mathematics, Science and Technology, Meeting Notes – Meeting of July 9-10, 1982, 3. Develop. File (2); Box 2; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴⁰² Ibid., 4

⁴⁰³ “Excerpt Relating to the NSB Commission on Precollege Education in Mathematics, Science and Technology from the Testimony of the Thursday, April 22, 1982 Hearing on the National Science Foundation Before the House Committee on Appropriations Subcommittee on HUD-Independent Agencies,” July 27, 1982, 1. Develop. File (2); Box 2; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

school mathematics...for graduation.”⁴⁰⁴ A recent Gallup Poll found that public opinion did not support this, with “91% of the public believ[ing] students should be required to take four years of mathematics in high school.”⁴⁰⁵ Math education, it was argued, was both due for reform and the tools were available to reform it.

Participants at that meeting no doubt engaged in some discussion on the status of mathematics education in the schools. Though detailed records of these conversations are not available, we do know that recommendations were made at this meeting to follow up on the problems in, and solutions for, mathematics education.⁴⁰⁶ These recommendations led the Conference Board of the Mathematical Sciences (CBMS) to hold a special conference the following September at the headquarters of the Mathematical Association of America (MAA). Present at the meeting were presidents of the major national mathematical organizations, as well as two members of the NSB Commission and two members of the Commission staff.⁴⁰⁷ Results stemming from conference discussions were presented to the Commission through the CBMS’s report, *The Mathematical Sciences Curriculum K-12: What is Still Fundamental and What is Not*.

Participants at the conference met in general agreement that the most pressing and immediate problem in precollege mathematics education was the need for more, and better qualified, classroom teachers. Yet conference participants did not suggest approaching this problem first; rather, many felt that appropriate changes in the curriculum would be a better approach, as this could “bring a new sense of vitality to K-12 mathematics” that might—along with encouraging students—encourage teachers to pursue professional development.⁴⁰⁸ The key to improving instruction, then, lay not with the instructors but with the curriculum.

The CBMS recommendations comprised specific examples and detailed guidelines about how to modify the curriculum and outlined strategies to develop student learning. In elementary mathematics the CBMS participants recommended a focus on the development of number sense—rather than drill in “formal paper-and-pencil computations”—that aimed to foster an understanding of the effective use of numbers in many applications. These changes in content were presented as “fairly substantial, but are primarily in emphasis rather than in overall content,” and are specifically mentioned to be in line with the recommendations put forth in *Agenda for Action*. The recommendations for the high school level include guidelines on how to improve instruction in topics such as proof in algebra, geometry, mathematical analysis, algorithms, and problem-solving, with recommended electives in topics like statistics and inductions.⁴⁰⁹ The report makes

⁴⁰⁴ Staff of the National Science Board Commission on Precollege Education in Mathematics, Science and Technology, “The Condition of Precollege Education in Mathematics, Science, and Technology,” June 1982, 8. Develop. File (2); Box 2; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴⁰⁵ “Summary, National Convocation on Precollege Education in Mathematics & Science May 12-13, 1982” undated, 6. 1st Operational File (3); Box 2; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴⁰⁶ The Conference Board of the Mathematical Sciences, “The Mathematical Sciences Curriculum K-12: What is Still Fundamental and What is Not” Preliminary Report to NSB Commission in Mathematics, Science, and Technology, October 4, 1982, 3. NSB Commis. on Precollege Education in Math, Science + Techn.; Box 3; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴⁰⁷ Ibid., 3.

⁴⁰⁸ Ibid., 4.

⁴⁰⁹ Ibid., 12-14

clear the perceived importance of reforming secondary mathematics, recording that participants agreed unanimously that there was substantial need for reform of subject matter and approach of teaching, with care taken “at all times to insure full consultation with and support from the secondary school mathematics teaching community.”⁴¹⁰ However specific recommendations for reform might be, it was thought they would never succeed without coherence of the community.

The recommendations regarding testing that came out of the conference are perhaps more interesting, and directed specifically at the Commission:

To a large extent the grade and high school teachers are under strong pressure to train their pupils so as to maximize their chances of doing well on the tests to which they will be subjected. As long as these tests stress computations, the pupils are bound to be drilled in computations, regardless of any other guidelines the teachers may have received, and even contrary to the sounder convictions the teachers themselves may have. We call the attention of the Commission to the power and influence standardized tests have. Properly modified, these can have considerable effect in hastening the hoped-for improvements in the present teaching of mathematics in grades K-12.⁴¹¹

Importantly, the CBMS participants did not decry the increasing use of standardized testing, but instead encouraged the Commission’s work in precollege education to embrace the possibilities and influence inherent in standardized testing and use such testing as a tool in the reform of classroom mathematics. The report stressed that conscientious development and responsible application of these tests was paramount:

In the United States, as many other countries, the syllabi of an extensive range of achievement tests play a very influential role in setting curricula and the actual classroom emphases of individual teachers. These mathematics tests – from minimal competence in arithmetic to advanced placement achievement and college aptitude measures – must be made to accurately reflect the underlying goals of any curricula put in place. If curricula are to be changed, the tests must be changed and this is an educational policy decision in which the interests of teachers, mathematicians, and a broad range of public opinions must be balanced. Strong national professional leadership is essential to implement significant change.⁴¹²

The recommendation by CBMS (and, in effect, the mathematics education community) to not simply reject widespread testing practices is crucial. From the beginning, identifying and defining standards and developing evaluative processes were central to the planned goals of the Commission, and these plans were reinforced in the recommendations of the CBMS. Commission members were charged with comparing

⁴¹⁰ Ibid., 14.

⁴¹¹ Ibid., 5.

⁴¹² Ibid., 10.

standards and expectation of competitor countries' educational systems with that of the United States, and also to examine domestic admissions standards, graduation requirements, and course offerings.⁴¹³ Mathematics would increasingly be used as a standard of measure for these criteria in an increasing slew of tests.

At the first public hearing held by the NSB Commission the attention to mathematics was also readily apparent. Vice-Chair Cecily Selby spoke in front of an Atlanta audience, opening with a discussion about how the Commission's first interim report went out to each school district, among other recipients. Importantly, however, she also informed attendees that the CBMS report was also available for those interested—no other disciplinary report was mentioned at this hearing.⁴¹⁴ (No other discipline had completed a report, though the Federation of Behavioral, Psychological and Cognitive Sciences had convened a meeting the previous month to identify findings from cognitive research that had implications for precollege teaching and learning.⁴¹⁵ As mathematics education, testing, and cognitive science continued to partner, this too was of importance to the mathematics education reform in the coming decades.) Later in the hearing another speaker again emphasized the importance of mathematics education in the Commission's recommendations, saying "a major predictor of success for students in science education and subsequent work in science is early entry into a well-defined mathematics sequence."⁴¹⁶ It was suggested that a major problem facing the Commission was the task of attracting students to mathematics courses in high school; to this end, standards were once again touted as an appropriate solution, in this case with stiffer graduation requirements providing incentive to increased enrollments. Though the Commission did attend to problems (and solutions) across all of math and science, the priority in mathematics education was stated in no uncertain terms to the public. Formal reports to the NSB mirrored the principal importance of mathematics to the Committee's discussions; an interim report presented in January noted that at a recent meeting between Commission members and representatives from higher education it was announced:

What is most important for entering students is facility in mathematics. Mathematics and science faculty want students to have interest in and curiosity about science. However, these individuals argued that, in terms of what entering students need, strong high school preparation in

⁴¹³ Excerpt from Keynote lecture by Dr. George A. Keyworth, II, Director Office of Science and Technology Policy, Executive Office of the President, and, Science and Technology Advisor to the President at the 148th Annual Meeting of the American Association for the Advancement of Science, Washington D.C., January 3, 1982," 2. Development File (2); Box 1; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴¹⁴ "NSB Commission on Precollege Education in Mathematics, Science, and Technology, Atlanta Meeting, December 15-17, 1982, Report by John H. Moore," January 7, 1983, 1. NSB Commiss. on Precollege Education – Highlights – Followup History (Membership Subfile); Box 4; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴¹⁵ NSB Commission on Precollege Education in Mathematics, Science and Technology, "Interim Report to the National Science Board," NSB-83-42, January 1983, 11. NSB Commiss. on Precollege Education – Highlights – Followup History (Membership Subfile); Box 4; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴¹⁶ "NSB Commission on Precollege Education in Mathematics, Science, and Technology, Atlanta Meeting, December 15-17, 1982, Report by John H. Moore," January 7, 1983, 1. NSB Commiss. on Precollege Education – Highlights – Followup History (Membership Subfile); Box 4; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

mathematics to the precalculus level is most important for making all of science, as well mathematics, viable options for students to pursue.⁴¹⁷

The influence wielded by the mathematics education community in effecting larger educational reform efforts could not be more clear.

By February 1983 the NSB Commission was busy moving through its task of defining the nation's problems in science and mathematics education and drawing up proposed solutions. Speaking before the House Committee on Science and Technology, co-chairman of the Commission William Coleman described the Commission's current, namely to provide for the nation information about what students should know or be able to do in math and science by the time they finish high school. Though Coleman made clear that he did not expect that definitive answers would be provided to this question in the eighteen-month duration of the Commission, he stated that the group would:

disseminate widely the results of those workshops and studies, with the hope of stimulating others to answer the important question of what exactly it is we are directing our educational efforts toward. I expect that among the Commission's recommendations will be suggestions of how that defining process might proceed and who should provide the necessary leadership.⁴¹⁸

The answers to that question would not likely be reached by the NSB Commission, Coleman explained, because the problem of educational reform was such a complex one. To emphasize this point he offered an example (in coincidentally mathematical terms), explaining that at one point in the Commission's deliberations a matrix was created "with aspects of the problem on one axis and potential players in solving the problem on the other axis. That problems-by-players matrix had 1,200 cells in it. Given this complexity, and the fact that there are 16,500 school systems in the United States, I doubt that we will find any simple, yet effective, 'quick fixes.'"⁴¹⁹ Despite this complexity, the Commission's goal remained to synthesize that mess of data into a set of concrete and widely-agreed upon—among all sectors, from the Department of Education, to professional societies, teacher organizations, the business community, and the public—goals, or, increasingly, the definition of benchmarks and standards. One of the reasons for aiming for standards was the importance of integrating assessment into curriculum reform projects and NSF initiatives more generally. A summary of NSF programs in precollege education notes the shortcoming of post-Sputnik education reform projects as the "failure to build into the educational system mechanisms for continuous re-examination and self assessment." Attempting through the NSB Commission to avoid

⁴¹⁷ NSB Commission on Precollege Education in Mathematics, Science and Technology, "Interim Report to the National Science Board," NSB-83-42, January 1983, 13-14. NSB Commiss. on Precollege Education – Highlights – Followup History (Membership Subfile); Box 4; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴¹⁸ "Remarks, William T Coleman Jr., Co-Chair National Science Board Commission on Precollege Education in Mathematics, Science and Technology, Subcommittee on Science Education, Research, and Technology, House Committee on Science and Technology, February 25, 1983," 6. NSB Commiss. on Precollege Education – Highlights – Followup History (Membership Subfile); Box 4; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴¹⁹ Ibid., 7.

this problem, the NSF began to build a formal assessment component into all of its programs.⁴²⁰ Such assessment, of course, required reliable data about the status of science education, a concern to which the NSF responded by establishing an Office of Studies and Program Assessment under the Directorate for Science and Engineering Education. This office was tasked with collection, analysis, evaluation, and dissemination of data, as well as for “designing and implementing systematic program evaluation of the impact and outcomes of past and present NSF support for science and engineering education.”⁴²¹ As existing frameworks for mathematics education reform already offered assessment mechanisms, and furthermore much longitudinal data on past programs was also accessible, precollege mathematics was a focus of much of these evaluative measures and corresponding effort at reform.

A Need for a New Sputnik

Even as both the NSF and the NCTM recommended action in mathematics education reform, the political climate remained non-conducive under the Reagan budgets and partisanship. Despite a lack of support from the administration, however, U.S. Secretary of Education Terrel Bell widely expressed interest in reforming math and science education, regularly meeting with representatives from the NCTM and other organizations. Unable to convince the Reagan administration of the importance of the endeavor, Bell used his authority to create the cabinet-level National Commission on Excellence in Education (NCEE), which produced *A Nation at Risk*.⁴²² This document, inflammatory and riddled with rhetoric [see Ch. 5], provided something of a “new Sputnik” in its ability to instill the nation with a sense of anxiety that centered on the perceived failure of American students in math and science. *A Nation at Risk* demanded not just action, but federal action, calling for “university scientists, scholars, and members of professional societies, in collaboration with master teachers, to help in this task, as they did in the post-Sputnik era. They should assist willing publishers in developing the products or publish they own alternatives where there are persistent inadequacies.”⁴²³ *A Nation At Risk* not only provided the context for support of reforms, but also shaped the very language of it:

Herbert: “Well, it was a big deal. It was a surprisingly big deal. And I’m not sure it has yet been fully analyzed. Maybe you’ll do that for us. It’s not clear to me that anybody knows anything more about the booklet than “nation at risk.” It’s a catchy title and that was it. And something’s wrong with education. And it’s more important than educators. It’s a larger issue than those who are professionally concerned with education. But it was all over the place. It was just awash [over everything]. And so we almost always tried to harness our own work in college preparation, in Green

⁴²⁰ “National Science Foundation Precollege Science Education Programs,” undated, 4. NSB Commiss. on Precollege Education – Highlights – Followup History (Membership Subfile); Box 4; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴²¹ Ibid.

⁴²² McLeod, “From Consensus to Controversy,” 764-765.

⁴²³ David Klein, “A Brief History of American K-12 Mathematics Education in the 20th Century,” in *Mathematical Cognition*, edited by James M. Royer, (Greenwich, CT: Information Age Publishing, 2003), 189.

Book and all that, to *Nation at Risk*. And we would say things like *Nation at Risk* says three years of mathematics, but we say... And so we just developed that dialectic all across the board. And that's how we tied our own case, as did everybody else, to *Nation at Risk*. It was the driver, you know. It sort of opened the ice flow. It cracked things and made all kinds of other things possible in its wake. Just tremendously powerful. I'm not so sure I could find in intellectual matters. Well Sputnik I guess. But there are not that many parallels."⁴²⁴

The influence of *A Nation At Risk* on the mathematics education community was tangible, directly inciting two meetings of particular importance. The first, in November 1983, was funded by the NSF and organized by the CBMS. Held at Airlie House in Warrenton, Virginia, the meeting began with a discussion of the NCB Commission report on the fundamentals in K-12 mathematics education. The report had recommended that professional organizations should take leadership for directing change in their fields; at this meeting, president-elect of the NCTM, Joe Crosswhite, introduced a motion that there should be a set of standards for school mathematics prepared by NCTM.⁴²⁵ The second meeting incited by *A Nation at Risk* was sponsored by the U.S. Department of Education, held at the University of Wisconsin in December 1983. This meeting produced similar recommendations about the need to have guidelines for curriculum development in mathematics.⁴²⁶ These meetings allowed offered a forum for the continued effort to maintain coherence within the mathematics education community on the important issue of reform, as well as “develop the lines of communication to the various communities that would be involved in the reform effort.”⁴²⁷ One of these communities would be, of course, the NSF.

The final report of the NSB Commission was released against the backdrop of the fervor surrounding *A Nation At Risk*. The Secretary of Education applauded the Commission report and said that he considered it to be “mutually reinforcing and complementing” to *A Nation At Risk*, and agreed that he saw “an important and continuing Federal role in education.”⁴²⁸ Bell urged continued collaboration between the Department of Education and the National Science Foundation. Senator Barry Goldwater of Arizona also spoke highly of the Commission report in his floor speech of September 15, 1983:

The Report to the American people provides a plan which has specific solutions, a process to determine Federal and state outlays, a set target date, and a set of national goals. The Report outlines bold approaches for change through an eight point strategy which meshes the needs and talents

⁴²⁴ James C. Herbert, *Work in K-12 Education Reform: Student Competencies, Curriculum Assessment, and the Language of Reform*, an oral history conducted 2012, Regional Oral History Office, The Bancroft Library, University of California, Berkeley, 2012, 40.

⁴²⁵ McLeod, “From Consensus to Controversy,” 766.

⁴²⁶ *Ibid.*, 767.

⁴²⁷ *Ibid.*

⁴²⁸ Patricia Nicely to NSB Commission File, memorandum, “Comments by Dr. Branscomb, Secretary Bell and Dr. Knapp at NSB Dinner, October 20, 1983,” November 16, 1983, 1. NSB Commiss. on Precollege Education – Report – News Release (Membership Subfile); Box 5; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP .

of diverse groups without sacrificing the integrity or the resolve of states and local school boards to determine for themselves the best methods to meet the goals with public and private sector participation through educational partnerships.⁴²⁹

Not everyone was convinced, however.

One mathematics education professor wrote to the National Science Board with tempered optimism, saying “[i]t seems likely that the mood of our legislators and policy makers is in harmony with the National Science Board’s recommendations for improvement of school mathematics and science programs. While it is unlikely that we will see the flood of dollars of the 50’s and 60’s, we might see a wavelet of federal support. I am hopeful.”⁴³⁰ Yet he noted a fear, as well, that the nation would “repeat major mistakes of the Sputnik-inspired era of federal support.”⁴³¹ Others were even less optimistic in their assessment of the tangible results of the Commission’s work. Anna Harrison, the president of the American Association for the Advancement of Science (AAAS), who served on the NSB for much of the 1970s, wrote to Branscomb reproaching the Board for negating its past responsibilities in precollege education and deriding the Commission’s report. “[T]here is nothing remarkable about the 1983 statements,” Harrison wrote. “Surely 25 people of the quality of the members of the National Science Board could have arrived at reasonable approximations of the 1983 statements in 1982 or 1981, etc. without the labors of a commission.” Harrison urged the Board to meet the challenge and “make the commitment and provide the leadership and support essential to a meaningful mathematics, science and engineering precollege education program,” even as she estimated that “[n]o Board in recent years has.” If the Board succeeded in this goal, Harrison assured she would “applaud with the greatest of appreciation and enthusiasm.”⁴³²

Harrison likely did not applaud, as the Board ultimately took up very little oversight of resulting action. In July 1985, the Director of the NSF, Erich Bloch, received a letter from one of Branscomb’s dissertation students in which she mentions that Branscomb was sorry the Commission was not “reassembled 18 months after they delivered their report to assess ‘progress’, i.e. implementation or lack thereof on their recommendations.” Branscomb had, during the first meeting of the Commission, made the promise this would be done about a year following completion of the Commission’s work.⁴³³ Jane Stutzman, Branscomb’s student, said, however, that such a meeting might

⁴²⁹ “Goldwater Supports 8-Point Strategy to Improve Science and Math,” undated, 1. NSB Commission on Precollege Education – Memo – Duplicate Copy “Educating Americans” (Membership Subfile); Box 5; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴³⁰ William L. Swart to Members of National Science Board, letter, November 23, 1983, 1. NSB Commission on Precollege Education – Report – News Release (Membership Subfile); Box 5; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴³¹ Ibid.

⁴³² Anna J. Harrison to Dr. Lewis M. Branscomb, June 30, 1983, 1-2. “Educating Americans” – Follow up history; Box 4; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴³³ “Remarks of Dr. Lewis M. Branscomb, Chairman, National Science Board, at the First Meeting of the NSB Commission on Precollege Education in Mathematics, Science and Technology, July 9, 1982,” undated, 4-5.

be “more of a P.R. move” than of any significance. “On the other hand,” she wrote, “it might send a signal about our sincerity in a) listening to input; 2) using it; 3) serious planning in SEE matters; 4) fit with Congressional interests. Downside is we might get lambasted for not following all their recommendations—who needs that!!”⁴³⁴

Stutsman’s letter implies a clear lack of follow-through from the NSF in addressing the recommendations of the NSB Commission. Even more demonstrative of the inattention to the Commission report was in Bloch’s response to Stutsman’s letter. On the letter itself he added a note that NSF leaders should “get the history together and discuss it in either an exec committee meeting or the [Education and Human Resources] committee meeting.”⁴³⁵ A memorandum was subsequently sent to the Executive Committee asking if such a reconvening of the Committee members was even appropriate, or if the Committee on Education and Human Resources was the best way to follow up on NSB recommendations. That this had not already been answered is indicative of some degree of inattention to the report. Bloch asks a broader question, as well, that indicates a lack of transparency: “what has happened nationally as a result of the many reports of the last few years, and the burst of activity at the state and local levels. Has any significant dent been made in the problems called out by the various reports?”⁴³⁶ In fact, significant work *was* being done, it was just not being led by the NSF. Instead, the mathematics education community had been functioning as a coherent and autonomous unit, in working toward solutions for effective reform.

Developing the Standards

A Nation at Risk called for standardized tests of achievement to be administered at major transition points of schooling, and administered as part of a nationwide—though not federal—system of state and local tests.⁴³⁷ This contributed to a rash of major state legislation being passed, “each law including the word *excellence* in its title.” These raised standards for teachers, initiated new testing and curriculum programs, and raised graduation requirements, with mathematics maintaining a central role.⁴³⁸ By about eighteen months after the publication of *A Nation At Risk*, an NSF-sponsored survey determined thirty-one states and the District of Columbia had some standards or guidelines for mathematics that were required or recommended—many that had just been implemented or were still in development; ten states had no guidelines at all, and ten

“Educating Americans” – Follow up history; Box 4; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴³⁴ Jane Stutsman to Erich Bloch, electronic message, July 22, 1985. “Educating Americans” – Follow up history; Box 4; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP; Box 4; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴³⁵ Ibid.

⁴³⁶ “Possible Specialized NSB Tasks for 1985,” 5-6, Attachment to Erich Bloch to Members of the Executive Committee, memorandum, “Possible Specialized NSB Tasks for 1985,” March 13, 1985. NSB Commiss. on Precollege Education – Highlights – Followup History (Membership Subfile); Box 4; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴³⁷ Klein, “A Brief History of American K-12 Mathematics Education,” 189.

⁴³⁸ Vena M. Long, “The Role of State Government in the Custody Battle over Mathematics Education,” in *A History of School Mathematics*, vol. 2, edited by George Stanic and Jeremy Kilpatrick, (Reston VA: National Council of Teachers of Mathematics, 2003), 945.

states did not respond to the survey. Though each state had unique sets of guidelines, most agreed upon at least a two-year requirement of high school mathematics.⁴³⁹

With the upswing of such legislation it was clear to many at the NCTM that the time had come to develop a set of standards to guide education policy in mathematics. In 1986 it was decided that a Commission on Standards for School Mathematics would be convened to develop a set of guidelines for curriculum, evaluation, and professional development under the leadership of James Fey and Joe Crosswhite. Initial plans for the standards document estimated that it could be prepared in one year with a budget of \$258,500. Ultimately the scope of the project was reduced, the project was extended to last four years, and the budget was increased to \$487,000.⁴⁴⁰ The NCTM planned to thus move ahead with a set of standards for curriculum and evaluation, and began to seek funding. Ultimately, however, very little money was procured, in part because the NCTM chose not to request funding from either the NSF or the Department of Education, “so that no claims could be made that the federal government had funded the development of curriculum and evaluation standards.”⁴⁴¹ This was not only a politically savvy choice, but also represented the interest within the NSF to maintain autonomy in this task: “The lack of outside funding allowed NCTM an independence that other curriculum areas did not always have...most NCTM leaders were pleased that they did not have to follow federal guidelines” for the project of creating standards.⁴⁴² Ultimately it was decided it was best to protect this autonomy and fund the project through internal NCTM funds. In March 1986 NCTM Board members unanimously approved the development of curriculum standards and funded the first phase of the project at \$150,000.⁴⁴³

Writing commenced on the *Curriculum and Evaluation Standards* during the summers of 1987 and 1988, with Thomas Romberg serving as director. The membership of the NCTM Commission on Standards for School Mathematics represented the NCTM Board, the MAA, the MSEB, as well as supervisors, publishers, and the mathematics education community generally.⁴⁴⁴ Drafts of the report were circulated widely throughout NCTM membership, in focused groups and commissioned reviews, and in nearly all segments of the mathematics education community for review and feedback.⁴⁴⁵ More than 10,000 copies of the revised 1987 draft were distributed for feedback, and the NCTM received more than 2000 responses. Most of the responses were positive (though a few considered it “the work of the Devil”), and suggestions were received that ultimately were used in revision of the final report.⁴⁴⁶ Annual conferences were also held with commercial publishers for their feedback and to discuss implementation strategies, an indication of the attention paid to the successful distribution of the NCTM Commission’s products.

⁴³⁹ “Education Commission of the States, 50 State Survey of Curriculum Guidelines,” November 1984, 1-2. NSB Commiss. on Precollege Education – Highlights – Followup History (Membership Subfile); Box 4; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science, and Technology, 1965-1982, RG 307; NACP.

⁴⁴⁰ McLeod, “From Consensus to Controversy,” 770.

⁴⁴¹ Gates, “Perspective on the Recent History of the National Council of Teachers of Mathematics,” 742.

⁴⁴² McLeod, “From Consensus to Controversy,” 772.

⁴⁴³ Ibid.

⁴⁴⁴ Ibid., 773.

⁴⁴⁵ Research Advisory Committee of the National Council of Teachers of Mathematics, “NCTM Curriculum and Evaluation Standards for School Mathematics: Responses from the Research Community,” *Journal for Research in Mathematics Education*, 19:4 (Jul., 1988), 338.

⁴⁴⁶ McLeod, “From Consensus to Controversy,” 779.

The goal of the NCTM's *Standards* program was not to produce revolutionary change, but to first develop the coherence necessary "to produce a consensus that was broadly acceptable to the field."⁴⁴⁷ The final report, largely referred to as the NCTM *Standards*, clearly outlined the empirical basis—both from programmatic research and cognitive research—for its recommendations, as well as documenting judgments and opinions from various experts. The document, too, was presented in terms accessible across the spectrum of the mathematics education community, making it useful to school practitioners, state school boards, and policymakers. To this end, *Standards* also included information regarding potential barriers to the implementation of standards that might be faced by educators or school boards, as well as those developing education policy. Though the new math was described as spreading through the country "like a rapidly burning brush fire," the NCTM *Standards* would need an even more dramatic metaphor; the wide-ranging and long-lasting influence of the NCTM *Standards* was unprecedented, and served to leave a lasting mark on the educational policies of the United States.⁴⁴⁸

The Influence of *Standards* on Federal Education Policies

The report's timing helped propel *Standards* to a place of importance in national educational policy; in September of 1989, just after the standards were released, President George H. W. Bush convened an education summit in Charlottesville, Virginia, to develop legislation guiding American precollege education. Diane Ravitch, assistant secretary for educational research and improvement in the administration, explained the importance of this convergence: "At the very time that governors and other political leaders wondered about the feasibility of voluntary national standards, there were the NCTM standards as an example for emulation."⁴⁴⁹

At this summit the President presented the governors with an extraordinary challenge: "By the year 2000, U.S. students will be first in the world in science and mathematics achievement."⁴⁵⁰ *Standards* offered an example—importantly one that could be considered, politically, a "free-market model for educational reform" rather than a mandate from the federal government—of the type of discipline-based standards and means of assessment that could be upheld in the nation's schools.⁴⁵¹ Such a challenge would require the formation of national standards by which students could be assessed. As formal national standards would no doubt prove politically tricky, evoking all of the familiar concerns about the balance of power between federal, state, and local, it was clear that the only option would be voluntary enforcement of standards by states and localities. As *Standards* was created by a non-governmental entity—or in other words, through the autonomy of the mathematics education community—it offered a crucial tool to federal education policy. At once, the goals of the mathematics education community to secure an avenue for disseminating curriculum were matched with the goals of federal education policy that sought a noncontroversial avenue to better control the education standards of the nation.

⁴⁴⁷ Ibid., 773.

⁴⁴⁸ Joel H. Spring, *The sorting machine revisited: national educational policy since 1945*, (New York: Longman, 1989), 80.

⁴⁴⁹ Diane Ravitch, as quoted in McLeod, "From Consensus to Controversy," 796.

⁴⁵⁰ "Chapter 1: Director's Overview," *National Science Foundation Annual Report 1991*, NSF 92-1, October 5, 1992. Accessed at <http://www.nsf.gov/pubs/stis1992/nsf921/nsf921.txt>

⁴⁵¹ McLeod, "From Consensus to Controversy," 795.

Both groups had mutual interest in publicity, which would serve to create the consensus needed for reform, as well as provide insulation against political opposition. The mathematics *Standards* remained central to this in concrete terms, rather than simply in a discussion about national goals: “President Bush and several state governors often waved a copy of *Curriculum and Evaluation Standards* in public, using the NCTM document as a literal, rather than simply a figurative, banner for the reform movement in education.”⁴⁵² The NCTM, for its part, also paraded around the *Standards*, scheduling national speaking tours, televised interviews, distributing materials, and other publicity efforts. To further aid in the adoption of the framework, NCTM developed a series of twenty-two booklets to help teachers implement standards-based curricula into their classrooms.⁴⁵³ Both the NSF and the federal government were coordinated in a joint effort to make the hard sell for standards.

It worked. After *Standards*, the U.S. Department of Education and other agencies began funding professional organizations’ attempts to draw up standards with minimal federal control. By 1995 it was shown that forty-one states had revised educational frameworks that reflected a “high degree of consistency” with the NCTM document “in language, grade-level organization (K-4, 5-8, 9-12), and focus on process as well as content.”⁴⁵⁴ Such standards were said to offer a coherent vision and a solid guideline for reaching goals of achievement, though the fact that the consistency emerged through *voluntary* implementation was politically important, and time and time again promoters from within the federal government and the mathematics education community reminded the nation (probably while waving around a copy of the report) that *Standards* was presented as “a banner, not a dogma,” instead offering only a “context of direction” for effecting change.⁴⁵⁵ They were intended to provide the assistance of discipline experts in helping states and districts compete on a national level while still controlling “the particulars at the local level... The NCTM standards are not intended to be a national curriculum; they are intended to provide guidelines and a vision for which mathematical concepts are important for all children to learn.”⁴⁵⁶

Yet despite the most careful attempts to present standards as mere guidelines, the very idea of standards—to be applied across all schools—was bound to lead to tensions. The authors of the NCTM *Standards* anticipated these tensions, and as a result the language of the report heavily emphasized the theme of consensus, emphasizing coordination among various entities in approaching mathematics education reform, rather than top-down oversight. These themes would come to dominate the discourse around one of the most expansive programs of education reform in the 1990s.

The Math Education Community and the NSF: A symbiotic relationship

Following the education summit of 1989, the director of Education and Human Resources at the NSF set forth concrete plans to make systemic changes in how math and

⁴⁵² Ibid., 796.

⁴⁵³ Gates, “Perspective on the Recent History of the National Council of Teachers of Mathematics,” 744.

⁴⁵⁴ McLeod, “From Consensus to Controversy: The story of the NCTM *Standards*,” 796-7.

⁴⁵⁵ Deborah Loewenberg Ball, “Implementing the NCTM Standards: Hopes and Hurdles,” prepared for a conference on Telecommunications as a Tool for Educational Reform: Implementing the NCTM Standards, December 2-3, 1991, Aspen Institute, Wye Conference Center, Queenstown, Maryland, 3, 15. Accessed at: <http://ncrtl.msu.edu/http/ipapers/html/pdf/ip922.pdf>.

⁴⁵⁶ Gail Burrill, “The NCTM Standards: Eight Years Later,” *School Science and Mathematics* 97(6) (October 1997), 335.

science were taught.⁴⁵⁷ These plans would ultimately come together in a program of systemic reforms spanning much of the 1990s. In his history of the mathematics education community, David Klein argues that this post-*Standards* reaction from the NSF was crucial to the overall adoption of the education reforms proposed by the NCTM: “Without the massive support [the NCTM *Standards*] received from the NSF, the sole effect of the *NCTM Standards* would have been to collect dust on bookshelves.”⁴⁵⁸ Yet upon closer examination, it seems that the converse argument holds some traction, as well: without *Standards*, the NSF’s programs in education may well have been relegated to outside the sphere of attention. While counterfactuals have little use in analysis, the truth remains that both the NSF and the mathematics education community had a stake in the fate of *Standards*. The productive partnership of the two in the evolution of the systemic initiatives and the move toward standards in the 1990s highlights the symbiotic relationship that existed.

By 1990, the *Standards* ushered in a profound emphasis on a need for “national dialogue” for reform in mathematics education.⁴⁵⁹ It was encouraged that everyone interested in math education—from K-12 educators to parents to policy makers to university educators—to work together to “create a system that will succeed in making high-quality mathematics the norm for every student.”⁴⁶⁰ This idea of a “system” would come to infiltrate the very core of debates on the future of education reform. Just as the mathematics education community recognized the need for coherence in moving ahead, it was so realized that reform of the nation’s classroom could not be expected to occur on a piecemeal basis. This included all aspects of the curriculum, from content to assessment. Reforms, should they be successful, would need to be national in scope, seeking systemic change.

The precise definition of systemic remained somewhat cloudy, but nevertheless the solution to the problems in education was seen to be in reforming the entire educational system of the nation—and to do so it seemed that the best bet was to start with mathematics. In 1990, immediately following the publication of (and response to) *Standards*, the NSF borrowed this language of systemic reform in the announcement its new program, the Statewide Systemic Initiative (SSI). SSI challenged states and local school districts to undertake ambitious, systemwide reforms, and offered substantial funding to those states interested in competing for awards to support reform efforts along the lines of systemic reform. Importantly, NSF’s guidelines for the SSI program required proposers to consider how the state’s policy documents were related to accepted educational standards in the field, with the guidelines specifically mentioned the NCTM documents as such “educational standards.”⁴⁶¹ In short, funding would not be granted to states seeking to update mathematics education without indication that plans were underway to adhere to the new NCTM *Standards*. Beginning in 1991, the NSF made five-year awards to states; in 1991 it made ten awards, eleven in 1992, and five in 1993.

⁴⁵⁷ Klein, “A Brief History of American K-12 Mathematics Education,” 193.

⁴⁵⁸ Ibid.

⁴⁵⁹ McLeod, “From Consensus to Controversy,” 787.

⁴⁶⁰ Gail Burrill, “National Council of Teachers of Mathematics: Changes in Your Classroom: From the Past to the Present to the Future,” *Mathematics Teaching in the Middle School* 4:3 (November-December 1989), 189.

⁴⁶¹ McLeod, “From Consensus to Controversy,” 797.

Though a few projects were extended past this time, the program was primarily phased out at the end of the third cohort's 5-year contracts.⁴⁶²

Systemic reform, as defined at the inception of the NSF's SSI program, was not a fully specified theory of change, but instead a concept that standards for student learning should form the basis for alignment of policies, practices, and resources throughout the educational system.⁴⁶³ The SSI program was an all-encompassing one in the American educational system [see Fig. 9],⁴⁶⁴ aiming to use standards and collaboration to impact all corners of precollege education. Yet the only standards available at the time of inception of the SSI program were those in mathematics; science education standards would not be released until the AAAS's Benchmarks for Science Literacy (1993) and the NRC's National Science Education Standards (1995), or well into the NSF's SSI program. The NSF thus developed its program based in large part on the standards outlined by NCTM, using them to "form the basis for alignment of policies, practices, and resources throughout the educational system."⁴⁶⁵ In this, the mathematics education community provided a resource to the NSF; in exchange, the NSF would provide a resource to the mathematics education community through support for and dissemination of the reforms.

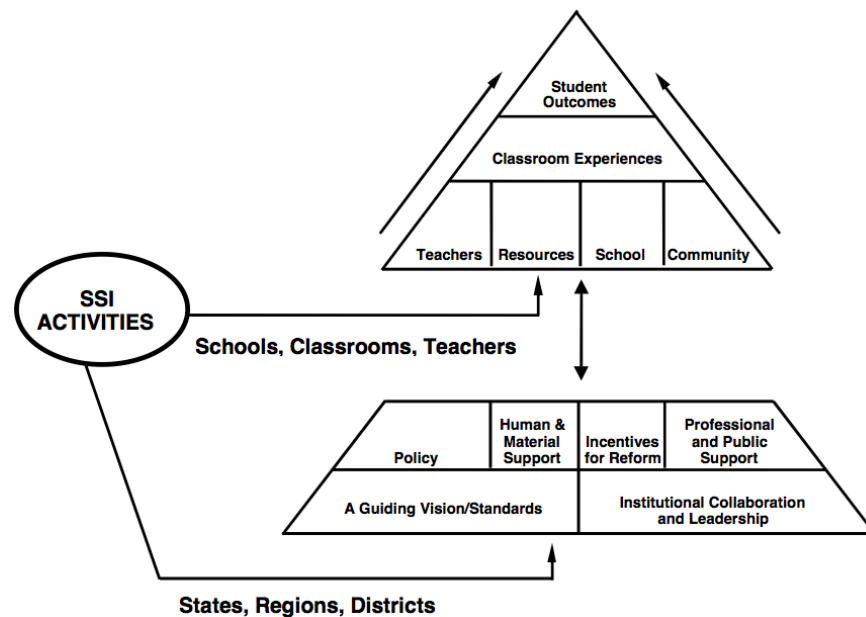


Figure 9

Though the voluntary nature of the adoption of particular standards was routinely stated to counteract charges of the "federal 'intrusion' into the sanctity of the state-local-private preserve of education," the actual situation was a bit more complicated.⁴⁶⁶ Typically, the NSF funded education programs (and programs in other directorates) through grants; the

⁴⁶² Andrew A Zucker, et. al. *A Report on the Evaluation of the National Science Foundation's Statewide Systemic Initiatives (SSI) Program*, (Menlo Park, NJ: SRI International, June 1998), 2.

⁴⁶³ Ibid., 3.

⁴⁶⁴ Ibid., viii.

⁴⁶⁵ Ibid., 53-54.

⁴⁶⁶ Gareth Davies, *See Government Grow: education politics from Johnson to Reagan*, (Lawrence, KS: University Press of Kansas, 2007). 18.

SSI program, by contrast, was funded through cooperative agreements with states. This allowed the NSF to “give technical and management advice as the projects are developed and implemented, and to establish agreed-upon, measurable project milestones.”⁴⁶⁷ It also gave the Foundation “greater-than-usual involvement” and an active role in monitoring the success of the programs. The NSF also required SSI programs to regularly provide data on the projects, documenting progress or failures. As a result of some of these reports the NSF terminated four SSIs before their three year term was completed.⁴⁶⁸

This new managerial role of the NSF had implications for the direction of federal education policy. Through a careful application of the idea of non-mandated standards available for voluntary adoption, the NSF—and in turn the federal government—did manage to sidestep some of the historic tension between local, state, and federal. Yet the actual influence of the federal government on policy was made clear through the ultimate authority wielded by the NSF in assessing states’ progress toward systemic reform—itself indicative of a kind of uniformity at a local, state, and perhaps eventually, federal level. Though individual states were only required to progress toward the alignment of their own established standards, testing, graduation requirements, curriculum materials, etc., the pervasive nature of the NCTM *Standards*—along with, of course, the requirement that proposers demonstrate adherence to accepted standards in the field—encouraged a de facto uniformity across a wider system:

One of the most common policy-related activities conducted by the SSIs was to contribute to the development of new or improved state curriculum frameworks in mathematics and/or science. In 11 states, the SSI directly invested time and money in the development of frameworks or content standards for K-12 mathematics... Since these documents typically set out ambitious goals for what students should learn and be able to do, they are logical starting points for systemic reform... In the model of systemic reform, the curriculum frameworks are one of the key documents used to provide a ‘guiding vision’ for the other components that make up the education system.⁴⁶⁹

In the years immediate following *Standards* it seemed almost possible that the centuries-old concerns about federalism might be put aside in a shared, unlikely goal of reforming education—starting with math. Federal education policy outside of the NSF also came to embrace the language and flavor of systemic reform. In April of 1991, President Bush announced his education strategy, *America 2000*, at a White House meeting, and included the announcement that the federal role in education would include defining “World Class Standards” in coordination with state governors, a result of the 1989 summit discussions. *America 2000* included six national goals for education, with the intent that individual states would “buy in” and work to achieve these goals. Bush pushed to develop a network of *America 2000* communities to support federal initiatives; in June 1991, Colorado became the first state to seek that designation, followed by Oregon. The two states were

⁴⁶⁷ “Chapter 3: Education and Outreach,” *National Science Foundation Annual Report 1991*, NSF 92-1, October 5, 1992. Accessed at <http://www.nsf.gov/pubs/stis1992/nsf921/nsf921.txt>

⁴⁶⁸ Zucker, et. al. *A Report on the Evaluation of the National Science Foundation’s Statewide Systemic Initiatives (SSI) Program*, xi.

⁴⁶⁹ *Ibid.*, 25.

governed by Democratic governors, thus helping earn America 2000 bipartisan support. Soon, a number of communities joined suit.⁴⁷⁰ Later that summer the newly formed National Council on Education Standards and Testing (NCEST) held its first meeting; by August it endorsed a set of key testing recommendations, including the development of national standards. Mathematics remained central to this recommendation—it was stated in this recommendation that priority lay with developing tests for mathematics, reading, and writing, with other core subjects to follow.⁴⁷¹ NCEST’s report symbolized an important shift—one “away from measuring and reporting the six national educational goals toward developing and implementing national content and performance standards and assessment.” In addition, the Bush Administration funded much of the preliminary research on systemic reform through the establishment of the Consortium for Policy Research in Education, which worked to disseminate the idea of systemic reform to policymakers and educators in the early 1990s.⁴⁷²

Despite support for national goals, the 102nd Congress did little legislatively to advance *America 2000*. Standards and goals, however, had become household terms in education policy following the release of *Standards*, so much state and local activities could be undertaken without formal congressional approval. Many hoped, upon the election of Bill Clinton to the presidency in 1992, that because of his past involvement in education—he was present at Bush’s 1989 summit—he would continue to be involved as president. Clinton’s transition team on education, with a K-12 Task Force led by Mike Smith, also urged continued attention to education by the new administration, saying that “[t]his agenda calls for high voluntary national standards and the provision of appropriate services to help assure that all students have a fair chance to reach these standards. To accomplish this, the Department of Education will need to create a coherent policy that integrates programs at the Federal level, and builds partnerships with states and local school districts around achieving high standards.”⁴⁷³

Clinton listened. Despite the importance of *America 2000* in driving reform, national goals had not been yet codified into law. In March 1994, this changed, as President Bill Clinton signed the slightly modified *Goals 2000* into law, thus making national standards—including two specifically focused on mathematics education—a matter of formal national policy. The law also created the National Educational Goals Panel, which worked “with the full partnership of Congress.”⁴⁷⁴ The Secretary of Education, Richard Riley, expressed his enthusiasm for the legislation, imbuing Goals 2000 with somewhat astonishing significance:

When the legislative dust settles and future historians examine the Clinton Administration, they will devote a major chapter to the Goals 2000: Education America Act...Like President Lincoln’s Morrill Act of 1862 and President Johnson’s Elementary and Secondary Act of 1965, President Bill Clinton’s Goals 2000 Act will stand as an education beacon.⁴⁷⁵

⁴⁷⁰ Maris Vinovskis, *From A Nation at Risk to No Child Left Behind: national education goals and the creation of federal education policy*, (New York: Teachers College Press, 2009), 50.

⁴⁷¹ *Ibid.*, 52-53.

⁴⁷² *Ibid.*, 57-58.

⁴⁷³ *Ibid.*, 65-66.

⁴⁷⁴ *Ibid.*, 68.

⁴⁷⁵ As quoted in Glenda Lappan and Jeffrey J. Wanko, “The Changing Roles and Priorities of the Federal Government in Mathematics Education in the United States,” *A History of School Mathematics*, vol. 2, edited by George Stanic and Jeremy Kilpatrick. (Reston VA: National Council of Teachers of Mathematics, 2003), 917.

Nevertheless, education in America was far from a closed book. As it became clearer that the original goals of 1965's Elementary and Secondary School Act might (still) not have been reached, Clinton passed its modified reauthorization as the Improving America's Schools Act (IASA) in October 1994. IASA was standards-based, aimed at all students, not just low income ones, and avoided direct federal control by mandating that each state be responsible for assessing students. IASA mandated that states create content standards that were supported by state testing and linked to local curricula and practices. Furthermore, IASA supported reform for all students—not for a particular subset—therefore making funds more flexible and thus federal dollars could be used to effect change in a more coordinated, systemic way.⁴⁷⁶

What that meant in practical terms, however, was unclear. Secretary Riley addressed these questions and explained what was meant by systemic reform:

[it] must address improved curriculum and instruction; assessments that tell us whether students are successfully meeting the standards; the preparation of teachers and principals to deliver the challenging content; parental and family support; the restructuring of schools; and the provision of real opportunities for students to move from school to work and / or college.⁴⁷⁷

Yet how to address these issues or assess the achievement of standards was not outlined, and there was confusion about whether the term implied uniformity of content standards or coordinated efforts across all education reform. In practice, “systemic” seemed not to have a set definition, even as the NSF had already spent millions of dollars to pursue the goals of systemic reform and the Department of Education seemed at the precipice of doing the same. When asked how Americans were to understand the definition of systemic, he replied: “However you want to take it, I guess.” State autonomy in developing plans under a national framework for systemic reform added to the confusion.⁴⁷⁸

Though political pressures and partisan disagreements would lead to a de-emphasis of the “national” part of the education goals (replaced with an increased emphasis on state and local autonomy in drawing up their own goals and standards), and even as the NSF's SSI program was phased out, the *Standards* helped usher in a new role for the federal government in education policy. Goals, standards, and benchmarks continued to structure the education reform efforts of the 1990s. The reform of whole education systems at the K-12 level and the development of “high-quality, standards-based instructional materials” remained two of the NSF's main priorities.⁴⁷⁹ Data on mathematics achievement and program successes, too, continued to be compiled at a rapid rate as the nation headed toward the year 2000, with many still focused on the goal

⁴⁷⁶ Glenda Lappan and Jeffrey J. Wanko, “The Changing Roles and Priorities of the Federal Government in Mathematics Education in the United States,” *A History of School Mathematics*, vol. 2, edited by George Stanic and Jeremy Kilpatrick. (Reston VA: National Council of Teachers of Mathematics, 2003), 919.

⁴⁷⁷ Vinovskis, *From A Nation at Risk to No Child Left Behind*, 68-69.

⁴⁷⁸ Ibid.

⁴⁷⁹ National Science Foundation, “A Message From NSF Director Rita R. Colwell,” *The Promise of Science and Engineering: An Investment in the Future: 1996-1997 Annual Report*, NSF 98-1, 1998. Accessed at <http://www.nsf.gov/about/history/nsf981/main.htm>

of American students' international preeminence in precollege mathematics achievement. The autonomy of the mathematics education community, from its ability to present a united discipline to its ability to independently fund research and development, offered to federal education leaders exactly the kind of "free-market model for educational reform" necessary to even begin a national discussion about educational standards. As it turned out, however, the influence of the mathematics education community on federal education policy allowed the national discussion of standards, assessment, and accountability to continue into the next millennium.

CHAPTER 5

WAKE UP AMERICA! YOUR CHILDREN ARE AT RISK: Mathematics education reform in an age of anxiety in America

In the early 1990s a team of researchers from the University of California, Berkeley asked a panel of scholars of American history and politics to quantify sociopolitical indicators of what they termed “national integration.” The survey aimed to analyze the degree of consensus among Americans about the nation’s identity, core values, and mission.⁴⁸⁰ Nineteen participants were asked to estimate the levels of national integration at four times in the nation’s history: 1930, 1950, 1970, and 1990. The study included nine indicators, the second of which involved education, asking participants to rate, on a 1-5 scale of “fully integrated” to “fully disintegrated,” if “Content of curricula in public schools contains agreed-upon core values” or if there exists “Conflict over which values should be included in public school curricula.” A fully integrated score earned a 1 rating, with 5 indicating a fully disintegrated consensus on core values in public school curricula. The results show a strong shift toward disintegration from the 1930s to the 1990s [Table 6].⁴⁸¹

Year	Numerical Rating	Std. deviation
1930	1.42	0.607
1950	1.47	0.612
1970	2.84	0.834
1990	3.50	0.928

Table 6

These results show a distinct change over time—or at least a perceived one—and a sense of increasing national fragmentation in how Americans thought about public school education.⁴⁸² In 1930 and in 1950, the participants generally agreed, there was a sense that precollege education reflected the values and identity of the nation. This sense waned by 1970, and even more so by 1990, with both of these years estimated to be more disintegrated than not, with more disconnect between the core values in the classroom the self-definition of the nation.

The implication of this survey is two-fold. First, the question arises of what happened over the course of these sixty years to change the way Americans think about education. Secondly, how—and *why*, exactly—is precollege education linked to the self-definition of a nation, of its core values and mission, of its very identity? This chapter aims to unpack both of these questions, exploring the continuous efforts to define a national identity in the context of evolving Cold War anxieties, and how this effort intersected with national efforts to reform precollege mathematics education.

Mathematics education is positioned as a crucial component of American domination over other nations in education, research, commerce, military strength, and

⁴⁸⁰ Jack Citrin et al., “Is American Nationalism Changing? Implications for Foreign Policy,” *International Studies Quarterly* 38:1 (Mar 1994): 1, 3.

⁴⁸¹ *Ibid.*, 4-5.

⁴⁸² Though the panelists themselves also demonstrated differences in opinions to the degree of national consensus, as shown in the increasing standard deviation, as the decades progressed.

economic interests. It is presented as at the core of the American national interest, and supporting cooperative, national reform has historically been championed in Washington as one-and-the-same as being a good and patriotic citizen. Yet perspectives on mathematical literacy vary considerably alongside the values and rationales of the stakeholders who promote them,⁴⁸³ inherently imbued with the social and political contexts in which they were created.

For this reason, the history of precollege mathematics education reform is necessarily a history in context—one that helps us better understand the historical values, intentions, and interests of those engaged in reform efforts. Understanding the pervasive link between mathematics education and evolving national anxieties in the twentieth century United States requires exploring how mathematics is so centrally interconnected with the Western world’s conception of *modernity* in its scientization, industrialization, and technologization—and in such, how mathematics remains synonymous with achieving goals of nationalistic preeminence, vanquishing foreign rivals, and maintaining economic dominance in a world market.

Modernization and Math

In considering the role of modernization in recent American history, intellectual historian Nils Gilman compares the obsession with the modern in post-9-11 America, noting that this moment in time bears strong resemblance to the American response to the early years of the Cold War. While many across the globe saw the chest-thumping assertion of global dominance and the assumption that American ideals would prevail as neo-imperialist, Gilman argues that this response instead demonstrated a severe anxiety about the state of the world and America’s place in it. The United States was undoubtedly threatened, and rather than emerging with confidence in an eventual triumph over the perceived evils that led to 9-11, instead the country was beset with a chilling vulnerability and anxiety about the future. This, Gilman asserts, is a response with strong parallels to the 1950s, another time in which the nation demonstrated a combination of anxiety and “a desire to deny that anxiety by shouting to the world how great we are.”⁴⁸⁴

While such a parallel might not offer evidence of some defining character of a continuous, collective American psyche, it does provide a jumping off point from which we can begin to understand the nation’s response to the perceived threat of the Cold War and the domestic policy that emerged in its wake. Much of the simplistic narrative that surrounds Cold War history centers on rising fear, yet equally important is the simultaneous fostering of a sense of national *optimism*. While this optimism might well have served as a thin cover for what was an entrenched cultural anxiety, it nevertheless drove a series of domestic policy actions aimed at highlighting American global preeminence. In so doing, this optimism “arose as a way to ward off the ghouls” of ideological enemies, and served to direct a search for national identity and national

⁴⁸³ Eva Jablonski as quoted in Christine Keitel, “Perceptions of Mathematics and Mathematics Education in the Course of History - A Review of Western Perspectives.” In Frederick K. S. Leung, Klaus-D. Graf, and Francis J. Lopez-Real, eds., *Mathematics Education in Different Cultural Traditions-A Comparative Study of East Asia and the West*, vol. 9 (Boston: Kluwer Academic Publishers, 2006), 91.

⁴⁸⁴ Nils Gilman, *Mandarins of the Future: Modernization Theory in Cold War America* (Baltimore: Johns Hopkins Press, 2003), ix.

mission that differentiated the United States from them.⁴⁸⁵ As Cold War historian Stephen Whitfield argues, the flip side of stigmatizing Communism was the “search to define and affirm a way of life, the need to express and celebrate the meaning of ‘Americanism.’”⁴⁸⁶ In seeking to define this way of life in the context of Cold War anxieties, Americans’ faith in the institutions of authority to uphold these newly defined values was strengthened.

This effort to define American values with an air of optimism can be seen clearly in the nation’s ongoing debates about and efforts toward reforming K-12 math education, beginning in the 1950s and indeed stretching to the post-9-11 America. This optimism championed the possibilities of American-style modernity and the reliance on science-based reform methods, yet this optimism was tempered—and at times eclipsed—by what Gilman describes as a nagging fear that “the house of cards might come tumbling down.”⁴⁸⁷ In the early years of the Cold War, efforts at education reform were guided by a rise of modernization theory that was defined as being scientifically (and economically) advances, based on rational technology and scientific knowledge, and prioritizing universal education.⁴⁸⁸ This modernization was strongly influenced by philosopher Hans Reichenbach’s 1951 *The Rise of Scientific Philosophy*, which posed that virtually every social issue in a democracy could be resolved by rational assessment—or the application of the scientific spirit to nearly all problems. Empirically, we could fix social ailments. Reichenbach listed examples of aspects of life that could be organized on a scientific basis, education being one of them. Although Reichenbach admitted that individuals might differ in opinion on these issues, he said these opinions are to be harmonized by “cognitive relations,” or understanding the relationship of means to ends.⁴⁸⁹ Many intellectuals, in the decade before and after Reichenbach’s influential text (and arguably since the late nineteenth century), were vocal proponents of this kind of “scientific culture.”⁴⁹⁰ Such a methodology toward solving social problems was hopefully perceived as distinctly American, and was expressed alongside a confidence that the United States should be a model for the world.⁴⁹¹ Although this manifested in a variety of postcolonial arenas, it is important too to understand how such a philosophy played out domestically.

This sense of optimism about the inherent modernity of the United States has far more interesting implications when one considers how it affected *action*. The modernization that arose in the early years of the Cold War emerged at a time when the United States was beset by a nagging feeling of vulnerability that ate away at the confidence built after a victory in WWII. This sense of vulnerability drove the nation to seek a better understanding what, exactly, defined American-style modernity, and how this would ensure a win for the United States against geopolitical ideological competitors. Optimism, then, extended beyond a simple declaration of preeminence and instead colored attempts to *improve* the nation by using principles of modernity that were understood to set America apart. Modernization theory dictated that scientific principles

⁴⁸⁵ Ibid., x.

⁴⁸⁶ Stephen J. Whitfield, *The Culture of the Cold War* 2nd ed. (Baltimore: Johns Hopkins Press, 1996), 53-54.

⁴⁸⁷ Gilman, *Mandarins of the Future*, x.

⁴⁸⁸ Ibid., 1-2.

⁴⁸⁹ David Hollinger, “Science as a Weapon in Kulturkämpfe in the United States During and After World War II,” *Isis* 86:3 (Sep. 1995): 447.

⁴⁹⁰ Ibid.

⁴⁹¹ Gilman, *Mandarins of the Future*, 4.

and the application of human will and reason could achieve progress. This progress was sought, among other areas of societal concern, in education reform, particularly as the achievement of precollege students in science and mathematics was increasingly understood to be a marker of Cold War victory. In such application, as Habermas observed, the foundational principles of modernity were ignored, with modernity instead stylized into “a spatio-temporally neutral model for the process of social development in general.”⁴⁹²

This tenuous grasp of the principles of modernity, however, is precisely what makes it so interesting when applied to the education reform efforts. In the wake of World War II and bolstered by the strident optimism that arose in the early Cold War as a way for the nation to “hide its anxieties in plain sight,” there was a widespread confidence about modernity and therefore modernization theory. Yet confidence in modernity declined as the idea that technocratic rational society was able to fix social and political ills broke down when it seemed clear that it had not worked.⁴⁹³ Increasingly, this optimism was replaced with pessimism as the nation struggled with its self-identity in the context of a losing war in Vietnam, a declining economy, and domestic problems that were not being solved with science. But even as domestic policies were increasingly questioned, education—and particularly mathematics education—remained an important factor exactly *as* the United States sought a national identity. As indicated by the abovementioned study, education is inextricably linked to national identity. As the nation moved through the twentieth century, its anxieties and optimisms changed in a context of a changing Cold War and the volatility of domestic issues; with these changes came an evolving relationship between the nation and the classroom.

But why mathematics? The K-12 math classroom shouldn’t necessarily enjoy such a strong link with national anxieties about wars or the economy, yet so often mathematics education is imbued with political urgency and flavored with national anxieties. Woeful cries of America “lagging behind” other nations in science and math education continue to litter our newspapers and magazines. International studies comparing mathematics achievement of American students are paired with sobering predictions about the fate of U.S. economic preeminence. Government leaders speak forcefully about the crisis in education and the need to better educate our students for the math and science needs of the 21st century.

The historical basis of this is not simply a post-Sputnik phenomenon, as so often the argument goes. In fact, mathematics education contributed to defining the United States throughout much of the 1900s. In the first half of the century, elementary and secondary school reforms mirrored cultural considerations of the changing ideal of the American citizen. Mathematics education standards and practices were aimed to prepare students for particular roles in society, and educators, parents, policymakers, psychologists, and mathematicians worked to effect reforms in classrooms and textbooks. As the century progressed, mathematics testing became important in building and ranking manpower to address military-based anxieties. By applying mathematical testing to soldiers, the role of mathematics as defining the strength of the American body became overt. As Sputnik’s 1957 launch accelerated both fears of decline and funding opportunities, math education reform served to symbolize the nation’s intellectual,

⁴⁹² Gilman, *Mandarins of the Future*, 7-8.

⁴⁹³ *Ibid.*, 248.

economic, and military preeminence. Yet as the context of the Cold War shifted, so too did national anxieties. As math education was firmly entrenched as a marker of preeminence, math education reform continued to hold national interest and reflect the country's anxiety about its position in the world, militaristically and economically. Charts and graphs were published widely with dire messages of American intellectual weakness. Television commercials dramatically portrayed the American classroom in a race with those of other nations. Test scores were touted as demonstrating objective national worth.

This cultural understanding of the role of mathematics proficiency developed in distinct ways throughout the 20th century. By examining its role as defining the strengths of the nation we can better understand how politics intersected with the classroom and how evolving standards of mathematics education were shaped by changing national anxieties.

The Early 20th Century

At the beginning of the twentieth century, secondary school enrollments expanded rapidly, from only about 11% of the appropriate age group in the U.S. attending in 1900, to 64% in 1934. With these growing numbers came a need to reconsider school curricula that had, to that point, not differed significantly from the European educational tradition. America sought to find its own, newly developed pattern in educating the nation's youth.⁴⁹⁴ The offering of education to the increasing masses self-consciously reflected the nation: as American industry rose to international dominance and maintaining economic supremacy was a central concern, American education was molded in economic terms, with mass public education modeled after the successes and efficiency of the assembly line. Notably, these Tayloristic ideas were reformulated in books such as Frank Bobbitt's *The Curriculum* (1918) and *How to Make a Curriculum* (1924), resulting in the concept that school instruction should have the goal of preparing students for skills corresponding to particular jobs. Educators and learning theorists alike—figures such as John Dewey and Edward Thorndike—espoused these ideas, thus strengthening the functional connection between employment, the economy, and education.⁴⁹⁵

A consensus among educators in the National Education Association had already begun to emerge in the early part of the century that “the schools were wasting time on productive instruction and that one needed to take a closer look at what the world outside the school did with ideas from various subjects.”⁴⁹⁶ In 1914, the NEA appointed a commission on the Reorganization of the Secondary School, charged to reconsider the goals of the nation's high schools. In 1918 the commission issued a report known as the “Seven Cardinal Principles of Secondary Education,” which had such a profound impact on the secondary school curriculum in this country that it has been called the single most important document in the history of American education.⁴⁹⁷ The fifth principle listed specifies the nation as a factor in educational ideals:

⁴⁹⁴ Geoffrey Howson, Christine Keitel, and Jeremy Kilpatrick, *Curriculum development in mathematics* (Cambridge: Cambridge University Press, 1981), 84.

⁴⁹⁵ *Ibid.*, 85.

⁴⁹⁶ Jeremy Kilpatrick, “A History of Research in Mathematics Education,” in *Handbook of Research on Mathematics Teaching and Learning*, vol. 1, edited by Douglas Grouws (New York: Maxwell Macmillan International, 1992), 17.

⁴⁹⁷ William Wooton, *SMSG the making of a curriculum* (New Haven: Yale University Press, 1965), 2.

Civic education should develop in the individual those qualities whereby he will act well his part as a member of neighborhood, town or city, State, and **Nation**, and give him a basis for understanding international problems... The comprehension of the ideals of American democracy and loyalty to them should be a prominent aim of civic education. The pupil should feel that he will be responsible...for keeping the **Nation** true to the best inherited conceptions of democracy...[Emphasis added]⁴⁹⁸

After the publication of the Principles, mathematics education concretely changed in American schools, as traditional mathematical offerings were not seen to be important for health, vocation, or citizenship per se. Traditional offerings of algebra and geometry began to be replaced with more “useful” courses such as shop mathematics, reflecting the influence of a societal, utilitarian philosophy.⁴⁹⁹ As the economy of the 1920s struggled and unemployment became a major domestic concern, a sort of educational utilitarianism flourished. The schools began to teach toward vocations, with mathematics course offerings relating to democracy, socialization, and the teaching of freedom of thought.⁵⁰⁰ As economic problems evolved into the era of the Depression, education was called upon—in what is known as the “activity movement”—to help students become economically successful and bring about societal change. In this effort, students were taught “life skills” mathematics, an idea supported by a 1938 report of the Educational Policies Commission titled *The Purposes of Education in American Democracy* that generally stated that most students only need arithmetic. At the same time, the government was becoming more involved in education by constructing more schools, providing free lunches, and providing part-time work programs for students as a part of Roosevelt’s New Deal.⁵⁰¹ With changing conceptions of the purposes of learning and the increasing influence of the federal government in schools, education reform faced both new opportunities and obstacles, just as did the nation itself.

World War II

For many, Roosevelt’s New Deal produced a new sense of exhilaration about being American as well as a new faith in the power of government; the outbreak of war only intensified these sentiments. During World War II, the nation became even more invested in social utility as it struggled to emerge from the grips of economic depression and to prepare for a world war. Mathematical utility changed in this context as well, drawing on increasing national anxieties and the optimism paraded out to defeat them.

As it became more and more clear that the United States would be entering into World War II, the Mathematical Association of America (MAA) and the American Mathematical Society (AMS) formed, in 1940, a Joint War Preparedness Committee. In May of the following year these groups issued a report, “Mathematics in the Defense

⁴⁹⁸ Emphasis mine. National Education Association of the United States, *Cardinal principles of secondary education. A report of the Commission on the reorganization of secondary education*, (Washington: Govt. print. off., 1918).

⁴⁹⁹ Wooton, *SMSG*, 3.

⁵⁰⁰ Martha J. Siegel, “Curriculum Development,” in *Mathematics Education in Secondary Schools and Two-year Colleges: a source book*, edited by Paul Campbell and Louise Grinstein (New York: Garland Pub., 1988), 47-48.

⁵⁰¹ Angela Lynn Evans Walmsley, *A History of Mathematics Education During the Twentieth Century* (Lanham Md.: University Press of America, 2007), 16.

Program,” which focused on the anticipated demands for the military and high school graduates for increased mathematical needs; “mathematical content with military uses is the most socialized variety of mathematics to which they [high school students, especially males] can be exposed at present.”⁵⁰²

It was thus understood that the military demanded mathematically trained personnel, yet a growing sense of crisis began to emerge, as many feared soldiers were unprepared. In such concerns, weak mathematics education *directly correlated* with weak armed forces. If American students failed in math, then, America failed as a nation. Exacerbating (and capitalizing on) these fears, Admiral Chester W. Nimitz, chief of the U.S. Navy’s Bureau of Navigation (and later Fleet Admiral of the U.S. Navy), spoke at the University of Michigan in October 1941. Commenting on the difficulty encountered by the Navy in finding officer candidates with requisite mathematical abilities, Nimitz recounted failure rates exceeding 60% on mathematics tests required for entry into the Naval Reserve Officer Training Corps. He also said that nearly 40% of college graduates who applied for other naval officer commissioning programs failed because of insufficient mathematical knowledge, and the 75% of the failures in navigation courses resulted from similar mathematical deficiencies.⁵⁰³ With soldiers needing to be retrained in mathematics to perform wartime activities, many argued that to be a successful country in both wartime *and* in peace, more mathematics—and not just practical mathematics—must be taught to students.⁵⁰⁴ This sentiment was reflected in the second report of the National Council of Teachers of Mathematics’ (NCTM) Commission on Post-War Plans (1945) as well as in the report issued jointly by NCTM and the U.S. Office of Education on “Pre-Induction [into the military] Courses in Mathematics” (1943). As the century progressed, the Cold War only served to exacerbate fears of a mathematically-illiterate military and dire warnings about this weaknesses in national security helped fuel education reform efforts. By 1977, in response to this stated “crisis,” the Navy started a “functional skills” program that covered mathematics and computation as well as reading and English composition. By the early 1980s, nearly 30 percent of recruits who enlisted in the Navy—or 27,383 of the 94,793 men and women—participated in this program, at a cost of \$2,041,844.⁵⁰⁵

The importance of mathematics was made clear to the American citizen during World War II, and many saw it as patriotic to promote mathematics since it was thought to support the war effort on all accounts. Patriotic rhetoric became intrinsically connected with mathematics, often intended to ‘draft’ students as well as teachers into national service with vital roles to fulfill and to build relationships between math and the war effort. In 1942, Colonel B. W. Venable on the War Department’s General Staff wrote that “fanfare and military glamour” might attract some students to take more mathematics and to learn more in them.⁵⁰⁶ In the same year, In 1942, the commanding general of the

⁵⁰² Alan W. Garrett and O.L. Davis, Jr. “A Time of Uncertainty and Change: School Mathematics from World War II until the New Math,” in *A History of School Mathematics* vol. 1, edited by George Stanic and Jeremy Kilpatrick, (Reston VA: National Council of Teachers of Mathematics, 2003), 498-499.

⁵⁰³ Ibid., 499.

⁵⁰⁴ Walmsley, *A History of Mathematics Education During the Twentieth Century*, 20.

⁵⁰⁵ Susan Walton, “A Generation Lags Behind As Science Advances,” *Education Week* II:39 (27 July 1983): 3. NSB Commiss. on Precollege Education in Math, Science + Technol. Newspaper, Memos, booklet; Box 4, ‘Educating Americans’ – Follow up history; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science and Technology, 1965-1982, RG 307; NACP.

⁵⁰⁶ Garrett and Davis, Jr., “A Time of Uncertainty and Change,” 502.

army's Services Supply Department, Brehon B. Somervell, claimed that "every classroom is a citadel," and he warned educators: "surely you will make certain now that no American soldier is ever killed or injured because you failed to do your part to provide adequate training."⁵⁰⁷ In no uncertain terms mathematics education was being aligned with national anxieties about the war in an effort to mobilize action to reform it.

Course content was specifically retooled to reflect the patriotic leanings sparked by the war. In 1942 the U.S. Commissioner of Education asked schools to incorporate military illustrations and applications in mathematics courses. In particular, aviation was seen to hold particular interest among American youth and curricula across the country was subsequently "air conditioned" to include this military-related content. Along similar lines, the Education Section of the War Finance Division of the U.S. Treasury Department published a guide, "The Teacher of Mathematics and the War Savings Program" with the aim of introducing "greater cooperation on the part of students and their parents in the voluntary savings program of the country."⁵⁰⁸ With math so closely tied to the armed forces and the anxieties of engagement, the war entered the American mathematics classroom and the lesson was clear: learn math—lots of math, and well—and America will come out on top.

In the Wake of War

Along with a changing attitude toward the role of math alongside national security measures came unavoidable new perceptions about the U.S. economy in a global context. Following the war, international collaboration became more commonplace, with the establishment of UNESCO and what would later become the Organization for Economic Cooperation and Development (OECD), yet countries maintained strict national boundaries: though many began to think more internationally, this was always within the framework of individual nations.⁵⁰⁹ The United States was no exception. The U.S. economy was the primary interest to Americans, and the goal was to maintain its position as globally dominant. Education continued to be a "step-one" in that process. Like the Smith-Hughes Act of 1917, the 1946 George-Barden Act emphasized agricultural, industrial, and home economics training for high school students. Education was understood as necessary for preparing students for the world of work.⁵¹⁰ Mathematics coursework was no exception to this rule; schools returned to non-militarized, practical mathematics, presenting math in a style that became known as "life adjustment education." This was soon to be questioned, as federal leaders examined the nation's relationship to science and mathematics more closely.

At the end of the war, per Presidential request, the director of the Office of Scientific Research and Development (OSRD), Vannevar Bush, prepared the report, *Science: The Endless Frontier*. In this report, Bush's argument for increased federal support of education was couched in the rhetoric of a war against disease, public welfare, and national security. Bush argued that the victory of the United States in World War II hinged on technical superiority and that without federal aid in peacetime, any future

⁵⁰⁷ Ibid., 503.

⁵⁰⁸ Ibid., 504.

⁵⁰⁹ Bob Moon, *The "New Maths" Curriculum Controversy: an international story* (London: Falmer Press, 1986), 45.

⁵¹⁰ Glenda Lappan and Jeffrey J. Wanko, "The Changing Roles and Priorities of the Federal Government in Mathematics Education in the United States," *A History of School Mathematics*, vol. 2, edited by George Stanic and Jeremy Kilpatrick. (Reston VA: National Council of Teachers of Mathematics, 2003), 899.

conflicts might result in defeat because of scientific deficiencies. Having thus effectively defined a vibrant anxiety for national contemplation, he issued a call for a renewal of scientific talent to meet these apparently obvious national security needs. *Science: The Endless Frontier* became a statement of national consensus about where the United States was heading, and how science—and math—would get us there.⁵¹¹

More importantly, Bush outlined a strategy that would place the oversight of scientific activity in the country in the hands of the federal government. In *Science: The Endless Frontier*, Bush recommended the establishment of the organization that would eventually be seen to fruition with the creation of the National Science Foundation (NSF). This new organization would effectively allow the federal government to both monitor and control the purse strings of a large proportion of the nation's scientific activity. As the Foundation grew and its mission expanded, programs in math and science education were increasingly included in NSF annual budgets.

Of course, Sputnik would change things, or at least amplify them. But even before the Russian satellite beeped its way into the American consciousness, an important consensus was growing that American education must be reconsidered. An educational researcher from wartime, Robert Gagné was entrusted in the 1950s to develop a curriculum for the training of the U.S. Air Force and, in doing so, came to realize that current approaches to education simply were not effective. Meanwhile, the public started to protest what was seen as a “watering down” of the curriculum in response to progressivism and life-adjustment education policies. During this decade the federal government and professional mathematics organizations expressed increasing concern about the recruitment and training of mathematicians at the doctoral and postdoctoral levels, as the demand for manpower had exceeded supply.

In the immediate post-war years, the NSF—newly established in 1950—was not equipped or even definitively authorized to tackle educational problems, yet the mere existence of the powerful NSF loomed large when looking for solutions to the widely understood problem of poor math and science skills among American students. Nevertheless, longstanding questions about the role of federalism demanded the NSF tread carefully if entering into education reform. There was a growing consensus within the young NSF that there was a need for action. Acknowledging the need did not immediately clarify how, exactly, the federal government could get involved; though many scientists had a realistic understanding of the role of science and society and sought to create a political structure in the postwar period that would tie basic research more closely to public welfare, it was particularly difficult to reconcile longstanding tensions between expert rule and democratic control, as well as those tensions between state, local, and federal governments.⁵¹² A suggestion issued by the Mathematical, Physical, and Engineering (MPE) Sciences Division at the NSF demonstrated the obstacles that the Foundation faced in developing a program of action in its obvious ambivalence on where that action should emanate from:

⁵¹¹ Ibid., 900.

⁵¹² Jessica Wang, “Liberals, the Progressive Left, and the Political Economy of Postwar American Science: The National Science Foundation Debate Revisited,” *Historical Studies in the Physical and Biological Sciences* 26:1 (1995): 140.

The high-school science teacher program (and curriculum problem) is so large that NSF may be able only to help point the way, but the National Science Board [the governing board of the NSF] might make a statement with respect to the gravity of this situation. It was agreed that the National Science Board should be advised that it is the feeling of the committee that the high-school teaching of mathematics and science is of such great importance to the scientific manpower and general welfare of the country that a national program should be developed to improve the situation.⁵¹³

Overall, however, it was understood that the new Foundation had a role to play—albeit a yet undefined one—in the teaching of secondary school science and mathematics. Certainly, too, the recommendation of a national program aimed at improving “the situation” intimated that responsibility should be placed squarely within some arm of the federal government’s National Science Foundation. How to organize such an endeavor, and where to place it within the Foundation, however, were questions beset with internal disagreements, external pressures, and government red tape.

In terms of *mathematics* education in particular, it is important to look at the early functions of the NSF. Questions of mathematics education (and research-level mathematics) at the time generally fell to the responsibility of the aforementioned MPE Sciences Division. Due to the relatively small number of mathematicians in relationship to practitioners of other physical and engineering sciences, the division had somewhat poor representation of the mathematical sciences, and those few that *were* involved feared a subsequently poor financial representation when it came to grant funding. In these early years, the mathematicians worked together in small efforts to assure continued support and a working relationship with the NSF—Division members threatened to quit, letters were written, and colleagues were reminded of the centrality of mathematics in the support of all the sciences deemed necessary for the improvement of the nation. One letter from a Louisiana State Professor in the early files of the MPE Sciences Division: “It is true that the direct fruits of pure mathematical research are not as spectacular as atomic energy, penicillin, or hybrid corn; but the influence of pure mathematics can probably be traced to some of these as well as to many other accomplishments of the human race.”⁵¹⁴ Math, the NSF was being reminded, could not be ignored in the effort to bolster American scientific production.

By 1955, with the NSF striding forward in educational efforts and the importance of mathematics training firmly present in national rhetoric, it appeared to many that the United States was well on its way to implementing solutions, or at least organizing to start discussing the problem. In this year, the Commission on Mathematics for the College Entrance Examination Board (CEEb) recommended “relatively minor changes in content, but tremendously important changes in the points of view of instruction, and

⁵¹³ Minutes of the Fifth Meeting Divisional Committee for MPE Sciences, November 20, 1953, 4. MPE/MPS Divisional Committee Minutes 1952-1965; Box 39; Records of the National Science Foundation, NSF Agency Historians Files, RG 307; NACP.

⁵¹⁴ Eugene Schenkman to Leon W Cohen (Schenkman to Cohen), November 17, 1953. Division for the Mathematical, Physical and Engineering Sciences MATHEMATICS; Box 11; Records of the National Science Foundation, Index Files of the Director, Waterman 1949-1963, RG 307; NACP.

major changes in teaching emphases.”⁵¹⁵ At first examination, this recommendation might seem benign—after all, the *content* of precollege mathematics education was to remain the same. The implications, however, of tailoring pedagogy and emphasis to the postwar world are telling. In this same year, and in the same vein, the Progressive Education Association was officially disbanded, as more and more Americans thought schools and traditional “life adjustment” were not preparing students for a more advanced world.⁵¹⁶ This was a world that was seen to be in a race to develop missiles and engaged in ongoing economic rivalries, a world in which nations had a vital state in the future of science and mathematics.

In this world the United States was most often placed at odds with the Soviet Union, seen to be “engaged in a quiet but horrible struggle to see which will be the first to develop and perfect the intercontinental ballistics missile...The first who has it perhaps could dictate terms to the other. From this [the United States] might be either permanently slave or permanently free.”⁵¹⁷ The Soviet Union was repeatedly branded “the competitor,” scientific and technical manpower “our most precious commodity,” and Americans were warned that falling behind in the production of engineers would doom the nation to, at best, second-best, militarily and economically.⁵¹⁸ In December 1955, NSF Director Alan Waterman gave a speech to the American Association for the Advancement of Science (AAAS) on “The Crisis in Science Education” that advocated for a more activist role for the NSF by contrasting Soviet and American education in science and mathematics. One of the areas Waterman suggested for NSF activity was in curricular reform.⁵¹⁹ This call for action was supported by an NSF-funded “manpower” project that resulted in the publication of Nicholas DeWitt’s *Soviet Professional Manpower*, which reported convincing data demonstrating the Soviets’ technological advances. The head of the House Appropriations Subcommittee that handled that NSF’s budget later read DeWitt’s book and told Waterman that he thought it should be distributed to every school principal in the country. Furthermore, he recommended that instead of the \$3 million the NSF was intending to request for fiscal 1957 for refresher courses for high school teachers, it should be asking for \$9-10 million. Though somewhat wary that this request would jeopardize other aspects of the budget, the NSF increased its funding to \$40 million dollars in 1957—a 250 percent increase from FY 1956.⁵²⁰

⁵¹⁵ Douglas B. Aichele, “Historical Overview,” in *Mathematics Education in Secondary Schools and Two-year Colleges: a source book*, edited by Paul Campbell and Louise Grinstein (New York: Garland Pub., 1988), 5.

⁵¹⁶ Walmsley, *A History of Mathematics Education During the Twentieth Century*, 22.

⁵¹⁷ William C. Foster *An Obstacle of Progress: A 1955 Chemical Progress Week Address*, Second Annual Observance of Chemical Progress Week 16-21 May 1955, 3. U.S. Education – State of; Box 1, Subject Files, 1951-1962; Records of the National Science Foundation, Subject Files of the Associate Director (Kelly). RG 307; NACP.

⁵¹⁸ Donald A. Quarles. 28 February 1955. Quoted in Manufacturing Chemists’ Association, “Fact Sheet on Status of U.S. Education Today,” 1955, 2. U.S. Education – State of; Box 1, Subject Files, 1951-1962; Records of the National Science Foundation, Subject Files of the Associate Director (Kelly). RG 307; NACP.

⁵¹⁹ J. Merton England. “The Federal Interest in Secondary School Science and Mathematics—the View from the NSF” in NSB/82-22 “Proposed Plan for National Science Board Special Commission on Science and Engineering Education,” 21 January, 1982, E-9. NSB Commiss. on Pre-college Education in Math, Sci. + Techn. (Development File) [2]; Box 1, Course Content – Development File; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science and Technology, 1965-1982, RG 307; NACP.

⁵²⁰ J. Merton England. “The Federal Interest in Secondary School Science and Mathematics—the View from the NSF” in NSB/82-22 “Proposed Plan for National Science Board Special Commission on Science and Engineering Education,” 21 January, 1982, E-8. NSB Commiss. on Pre-college Education in Math, Sci. + Techn. (Development File) [2]; Box 1, Course Content – Development File; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science and Technology, 1965-1982, RG 307; NACP.

It was this struggle for supremacy—political, military, economic, and technical—over the Soviet Union that was repeatedly as the reason for increased interest—and greatly increased federal funds—for supporting education projects. In the Director’s Statement for the sixth annual report of the NSF, Waterman described the weakness of the United States as being the critical shortage of well-trained scientists and engineers produced in the country (particularly in terms of national security in a world containing the Soviets). These shortages, he argued, directly, immediately, and practically affected U.S. capabilities in national defense, strength, and welfare.⁵²¹ Waterman continues, further strengthening his claim that the path to national supremacy begins in the classroom: “The nations of the world recognize the importance of progress in science and technology to economic and military strength... To these ends, an adequate and continuing supply of competent scientists, engineers, and technicians is indispensable.”⁵²²

Clearly, armed with an ever-growing arsenal of anxieties and gearing up for mobilization, Americans were already well prepared for the aftermath of the Sputnik launch.

The 184-pound Problem

After Sputnik, the exercise-ball-sized metal sphere equipped with a one-watt radio, new—or at least heartily revived—national anxieties were launched. Schools almost overnight switched from a life adjustment philosophy to a more rigorously academic one. In the first four years after Sputnik alone, federal investment in research and development more than doubled. Indeed, the Association of American Universities argued, “the greatest scientific and national security significance of Sputnik was America’s response to it.”⁵²³ Overnight, with Congress’s 1958 National Defense Education Act, the federal government went from being basically a social bookkeeper in education to intervening *directly* in the classroom. As one reporter put it, “The act targeted science, math and foreign languages as critical subjects, and for the first time, the government’s attention was directed toward constructing curricula instead of constructing buildings and collecting statistics.”⁵²⁴ Though in previous year NSF policy-makers had to be pushed into sponsoring institutes, they now “welcomed the chance to support the development of new high school science and mathematics courses”—in part made legally and publically more acceptable by the post-Sputnik passage of the National Defense Education Act. These new programs were understood at the NSF to serve the ideal of science, if also to help build the supply of scientists and engineers needed for the nation’s defense and economic well being.⁵²⁵

It is crucial, however, to understand the national and federal responses to Sputnik as only *accelerated* by Sputnik, not directly caused by its launch. Dire warnings of the implications of scientific and technical manpower were already being tossed about in newspapers and in the halls of the NSF. The Soviet Union was already the “competitor.”

⁵²¹ Alan T. Waterman. “Directors Statement for Sixth Annual Report.” [draft] 1956, 1, 3. Annual Reports – NSF First through Sixth; Box 1; Records of the National Science Foundation, Index Files of the Director, Waterman 1949-1963, RG 307; NACP.

⁵²² Ibid.

⁵²³ Stuart Tannock, “To Keep America Number 1: Confronting the Deep Nationalism of US Higher Education,” *Globalisation, Societies and Education* 5:2 (July 2007): 258.

⁵²⁴ Vernon Loeb, “Americans Beaten to the Scientific Punch Again” *Philadelphia Inquirer, The (PA)*, October 10, 1982, F edition.

⁵²⁵ J. Merton England, “The Federal Interest in Secondary School Science and Mathematics,” E-14.

Our national security was seen to be in peril even before the 184-pound problem of Sputnik orbited the globe for three months. Certainly, Sputnik incited more action and more noise, yet it is historically inaccurate to imbue that little satellite with the national ethos that came to characterize the Cold War era.

Why, then, is it so commonplace to mark October 4, 1957 as the day the U.S. realized its students were falling woefully behind? In large part that memory has been created because that date *does* mark the time when Americans were not only subjected to constant and far-off beeping from a radio signal out in space, but also the increasing articulation from leaders in Washington—often delivered sermon style—of the need to solve the problem—nay, crisis—of American math and science education. Immediately following the launch of Sputnik, the U.S. Secretary of Health, Education, and Welfare, Marion B. Folsom, sought to use Sputnik’s image to bring to the President’s—and the nation’s—attention the necessary actions facing the United States. Using phrases like “tragic waste,” “the urgency of our times,” and “preserve our freedom,” Folsom sent a memo to the president before the end of 1957 that outlined several new proposals in education that he boasted illuminated some “plain truths”:

First, education is now more crucially important to long-term national security than ever before. Second, there are deficiencies in education which could dangerously weaken our national security effort in these perilous times. Third, it would be sheer negligence for the Federal Government to take a do-nothing attitude toward problems in education which threaten the survival of our freedom. In light of these truths, the administration has developed a four-year program of Federal support to help meet certain critical needs... We believe Federal funds in these areas will accomplish the most far-reaching good from the standpoint of the national interest and national security in today’s world... To do less would leave a dangerous gap in national progress and in our efforts to preserve our freedom.⁵²⁶

Leaders in Washington were not the only actors emphasizing the import of Sputnik and the specter of a Russian preeminence. News reports following Sputnik claimed that the United States was producing fewer mathematicians and scientists than the Soviet Union. The U.S., it was stated, had “gone soft” on education and by not emphasizing the rigors of mathematical and scientific thinking was setting itself up for dire shortcomings in national security issues.⁵²⁷ The NSF unsurprisingly also entered the fray, as existing programs and interests within the Foundation stood to benefit from the emotional response in Washington. Soon after the launch, Waterman observed that Sputnik—or as he called it, a “scientific Pearl Harbor”—“provided an opportunity for the Foundation to do what it had previously regarded as urgent and to consider what more

⁵²⁶ Marion B. Folsom, Draft statement. December 20, 1957, 1, 6. Division of Scientific Personnel and Education; Box 39; Records of the National Science Foundation, Index Files of the Director, Waterman 1949-1963, RG 307; NACP.

⁵²⁷ Lappan and Wanko, “The Changing Roles and Priorities of the Federal Government in Mathematics Education in the United States,” 903. For more detailed discussion of the rhetoric of masculinity in the Cold War, see K. A. Cuordileone, “‘Politics in an Age of Anxiety’: Cold War Political Culture and the Crisis in American Masculinity, 1949-1960” *The Journal of American History* 87:2 (Sep. 2000), 515-545.

should be proposed.”⁵²⁸ Indeed, the NSF quickly moved to avail itself of the green light it was given to pursue education reform efforts—importantly, it did so in part through efforts in mathematics. In 1958, the National Science Foundation sponsored a conference of mathematicians in Chicago where it was stated that the problem should be bottom up: K-12 mathematics needed to be the starting point for reform.⁵²⁹ Prominent reporters, officials, and members of the military espoused the idea that in time of war—cold or otherwise—education fell under the umbrella of national policy.⁵³⁰ In the global Cold War that was unfolding, education was understood to be the first line of defense, with Sputnik helping to launch a volley of attacks against the U.S. educational system and challenging it to change. In no uncertain terms were the mathematical skills of our students both central in American self-identity and wholly conscious of the nation’s fears: the U.S. Commissioner of Education, Lawrence Derthick, used the following analogy in a number of speeches: “The Soviet Union is like one vast, sprawling college campus on the eve of a football game with its great rival. That rival is the United States. The game is economic and cultural conquest of the world.”⁵³¹

With American skills in mathematics placed squarely under the umbrella of national security issues, the federal government was in place to embrace responsibility for overseeing—and improving—mathematics education in an utterly new (and Constitutionally hairy) manner. A report from the President’s Science Advisory Committee (PSAC) in 1958 emphasizes the federal government’s interests in education, outlining the “ways in which our education can be strengthened so that it will more fully meet the requirements of this age of science, and best serve the nation in this period when the security of the Free World and the defense of human freedom are inescapable responsibilities of the United States.”⁵³² Not only was education equated with democracy, but also the report asserts that the problem is *uniquely* American: “The educational needs and problems of each nation have their own particular flavor. No Nation can copy another.”⁵³³ An American problem, then, requires an American solution, and PSAC asserted that it is imperative to address the nation’s math and science capabilities, lest America fall behind. Ignoring math, science, engineering, and technology would undoubtedly, according to the President’s Council, doom the country to “unnecessary weakness and backwardness in a world where other nations are not so foolish.”⁵³⁴

The importance of painting math and science skills as a national problem—and one described in highly nationalistic terms—cannot be overstated. What might seem to be simple political rhetoric had far reaching implications to the nation’s governance. K-12 education, an area long overseen by state and local jurisdiction, slowly crept under the thumb of folks in Washington. This was achieved not without resistance, however

⁵²⁸ Minutes of the Twenty-Fourth Meeting of the Divisional Committee for Scientific Personnel and Education. November 14-15, 1957, 2. Divisional Committee for Scientific Personnel and Education- 1960 and back; Box 52; Records of the National Science Foundation, Index Files of the Director, Waterman 1949-1963, RG 307; NACP.

⁵²⁹ Wooton, *SMSG*, 9-10.

⁵³⁰ Lappan and Wanko, “The Changing Roles and Priorities of the Federal Government in Mathematics Education in the United States,” 901.

⁵³¹ *Ibid.*, 904.

⁵³² President’s Science Advisory Committee (PSAC), “Education for the Age of Science” 1958, 1. President’s Science Advisory Committee – 1958 Education Panel; Box 37; Records of the National Science Foundation, Index Files of the Director, Waterman 1949-1963, RG 307; NACP.

⁵³³ *Ibid.*, 2.

⁵³⁴ *Ibid.*, 4.

Sputnik fever, combined with the chilling reality of a Soviet atomic bomb, ushered many Americans to duly accept the new necessity of government involvement in our classroom—government involvement in the laboratory won World War II, after all, so perhaps it could win the Cold War from the classroom.

Mathematics education played a particularly important role in this shift, despite the understanding that “the direct fruits of pure mathematical research are not as spectacular as atomic energy, penicillin, or hybrid corn.”⁵³⁵ Nevertheless, math was the clear prerequisite for those science and engineering skills that were thought to hold the key to American superiority on the globe—if scientists and engineers were to win the Space Race and secure the economy, their language would undoubtedly be mathematics. Furthermore, the *existing educational structure* of mathematics in the K-12 classroom positioned mathematics to have a starring role in emerging government involvement of education. Math was already a constant in American schools, with instruction beginning at the most elementary of grades. There would be no such question of whether “physics first” was appropriate, or whether biology should fall before or after chemistry in the curriculum. Math was already firmly a part of the entire K-12 curriculum, continuously serving evolving conceptions of utility, from life adjustment philosophies to providing the language of the Cold War. Math, then, would prove to be central in the story of the federal government entering the classroom.

In this consideration, the most important component of the 1958 PSAC report is in its concrete recommendation that present efforts in course content improvement be “aggressively pursued and substantially expanded in bringing together leading scientists, scholars and teachers in these various subject matter fields.”⁵³⁶ With this recommendation, the federal government encouraged the organization of curriculum improvement projects—a project already undertaken by the NSF and therefore the oversight of a national effort would naturally fall under the Foundation’s purview. Two such projects in mathematics were soon added to the budget of NSF in the wake of Sputnik. The University of Illinois Committee on School Mathematics (UICSM) was adopted by the NSF as an existing program that had previously been sponsored by private, non-federal funding. This group had, since 1951, been developing an introductory course in high school mathematics, complete with textbooks and other curricular materials. The second was the School Mathematics Study Group (SMSG), a group of mathematicians and educators organized with funding from the NSF to create curricula for primary and secondary mathematics instruction. Both projects are described in more detail in other sections of this dissertation, however it is crucial to recognize that these two projects mark the official entrance of the United States federal government into the K-12 mathematics classroom. Furthermore, it did so with far less criticism than did it garner applause for its efforts, at least in these early years in the development of the “new math” curriculum for American schools.

While some research in mathematics education was *not* being conducted with American preeminence in mind, post-Sputnik funding continued to flow if research was presented in these terms. Some saw the pursuit of the “new math” as hope for the nation, but for others, namely many researchers in learning theory and educators in the classroom, the new math represented a way to improve mathematics education for its

⁵³⁵ Schenkman to Cohen.

⁵³⁶ PSAC, “Education for the Age of Science,” 29.

own sake. Still, aligning research and practice with national goals was key to garnering support though Cold War historian Jessica Wang cautions against assuming that American scientists were complicit in their relationship in the national security state, even if they were well aware of it:

The Cold War political consensus was overwhelming. Every major sector of American society—including business, labor, liberals, the universities, the professions, the family—accepted or at least adjusted to a political and cultural regime based on an assumption of perpetual U.S.-Soviet conflict... By 1950, there was little room for non-conformity in American political culture.⁵³⁷

The pervasive nature of anxiety over U.S.-Soviet conflict was inescapable in this context, and even those who looked to reform math education for its own sake were forced to grapple with the widespread perception that the U.S. was woefully trailing the Soviet Union.

This race with the Soviets served to justify new federal programs in education throughout the 1950s and 60s, though the 20th century would eventually see the introduction of new competitors. Education was championed as the only way to preserve American technological and economic preeminence, as well as those democratic freedoms seen as threatened by encroaching Communism. Dael Wolfle, executive director of the AAAS, explained, “The importance of education is obvious. The United States must develop all the talent it has, and the ideal of helping each person to develop to the highest level he can is basic to the whole concept of a free society.”⁵³⁸ It was, of course, seen as problematic that Soviet students, despite being governed under Communism, were, by many measures, outperforming American students.⁵³⁹ Wolfle admitted to the possibility of learning from “some European countries about education for the intellectual elite even though we reject the entire system as incompatible with our democratic ideals.”⁵⁴⁰

As it turned out, however, continued attempts to learn from competitors led America to fundamentally doubt its natural preeminence, using student performance as a measure of national strength and a stand-in for technological, scientific, and economic prowess. In 1959, Harry Kelly, the Assistant Director for Scientific Personnel and Education (SPE) at the NSF spoke before a group of high school principals about his experience visiting and observing education in the Soviet Union: “I was eager to go to Russia for first-hand observation, because programs of the National Science Foundation designed to improve United States competence in science were in some measure determined by Soviet activities. This was especially true of our programs in education in the sciences.”⁵⁴¹ What he found, however, was a strong challenge from the Soviets that

⁵³⁷ Jessica Wang, “Liberals, the Progressive Left, and the Political Economy of Postwar American Science,” 166.

⁵³⁸ “Education for a Stronger Nation: A Brief Summary of a Paper by Dr. Dael Wolfle” 1958, 1. President’s Science Advisory Committee – 1958 Education Panel; Box 37; Records of the National Science Foundation, Index Files of the Director, Waterman 1949-1963, RG 307; NACP.

⁵³⁹ *Ibid.*, 2.

⁵⁴⁰ *Ibid.*

⁵⁴¹ Harry C. Kelly, “Impressions of Science in the Soviet Union” Presented to 43rd Annual Convention of the National Association of Secondary School Principals” February 9, 1959, Statement before the Independent Offices Subcommittee of the House Appropriations Committee, April 24, 1961, 1. Hearings FY 1961 + 1962; Box 2, Subject

he felt necessitated a critical examination of American education and a subsequent plan for improvement. Kelly spared no words in bolstering a spirit of competition between the two nations, referencing the Soviet's battle cry of "BEAT AMERICA in industrial and agricultural production, in foreign trade, in political and cultural domination of the world."⁵⁴² Kelly capitalized on the nation's anxieties in urging the American people to bring about "wise, daring, and cooperative efforts" in reforming American education.⁵⁴³ Though a broad education was of course recommended, it was in science and mathematics that the major efforts were heavily pursued and funded. The general consensus in these early years of the Cold War was that education would not only secure the freedoms espoused by the Constitution and strengthen military capabilities, but would also be a "cement that helps bind the thousands of American communities, and the forty-eight States, into a nation."⁵⁴⁴

Such a unified nation and well-defined national identity based on principles of education requires some sort of common intellectual language, and here again mathematics played an important role. Math, being constant in the K-12 curriculum, and furthermore being easily adaptable to standardized testing—across the nation and in international distribution—was more and more used as the unit to measure students' ability. As the United States raced to produce intellectual commodity in the form of trained students, mathematics served as a yardstick—it was a subject crucial to the needs of the modern world, and one that could be readily tracked and recorded at various times throughout K-12 education. Simply recording, however, was not seen to be enough; the mathematics education community—now with the support of the federal government—aimed to forge ahead and bring America tools from a "new math" with which it could flourish scientifically, technologically, economically, and politically.

Building a New Math for the Nation

By the 1960 presidential election, Americans were clear in their desire for an aggressive leader to fight the Cold War. Kennedy used this to his advantage, charging that the Republicans had allowed a missile gap to exist, but importantly he steered his campaign to *domestic* issues, even as the Cold War largely played out as a crisis of foreign relations. To many, Kennedy symbolized a hope that social and economic problems could be solved, including urban decay and the decline of schools. The 1960 election saw a tremendous increase in voter turnout, and Kennedy, with his youthful enthusiasm, won the election and helped foster optimism in forming a new, improved national identity.⁵⁴⁵ Along with other domestic issues, education became a focus of federal attention and a weapon in the fight against ideological enemies abroad and rising anxieties at home.

Though programs aimed at improving mathematics education in American schools existed before Sputnik, the resources made available beginning in the late 1950s helped fund dozens of new projects. By the early 1960s, the NSF was funding a number

Files, 1951-1962; Records of the National Science Foundation, Subject Files of the Associate Director (Kelly). RG 307; NACP.

⁵⁴² Ibid.

⁵⁴³ Ibid.

⁵⁴⁴ Jerrold R. Zacharias, "Role of Federal Government in Education," undated, 2. President's Science Advisory Committee – 1958 Education Panel; Box 37; Records of the National Science Foundation, Index Files of the Director, Waterman 1949-1963, RG 307; NACP.

⁵⁴⁵ Stephen J. Whitfield, *The Culture of the Cold War* 2nd ed., (Baltimore: Johns Hopkins Press, 1996), 209.

of mathematics curriculum reform projects, the largest and most notable being SMSG. Continued support of such programs, however, required continued Congressional appropriations for the NSF's ever-increasing budget. Support from Washington, at the time, was somewhat stable and relatively promising—President Kennedy's 1961 State of the Union address explained that America lacks "the scientists, the engineers, and the teachers our world obligations require ... Federal grants for both higher and public school education can no longer be delayed."⁵⁴⁶ However, maintaining math education's position as a fundamental component of the nation's national security and economic dominance was crucial.

International competition continued to justify motions for improvement of American science and math education. In March of 1960, the NSF put together a draft outline that listed potential topics to be brought up with the House Appropriations Committee. One topic included was the presentation of comparisons of science and math degree holders, scientific professionals, and school enrollment between the U.S. and the Soviet Union.⁵⁴⁷ In the same year, at the thirty-fourth meeting of the NSF's Divisional Committee for Scientific Personnel and Education (SPE), members convened to discuss the issues to be brought to the Appropriations Committee. It was at this meeting that members of the SPE Division clearly articulated the balance between the stated mission of the NSF with the reality of obtaining Congressional funding: namely that aligning research proposals to national anxieties was likely necessary to include in the NSF's attempts to secure funding, despite misgivings from within the NSF of using such techniques.

At this meeting, Harry Kelly outlined the "overall problem of the general order of magnitude of Federal support for science education," emphasizing that "the Soviet Union and Red China are increasing their numbers of scientists and engineers at a greater rate than the United States." One member, Warren Weaver, however, disagreed with Kelly's concern over the "great economic, military, political and cultural challenge" from Russia, maintaining, "Putting emphasis on numbers in terms of competition with Russia did not seem to be the essence of the problem." Another member, Charles Dollard, echoed Waterman's reticence to too closely align with Cold War rhetoric, explaining, "There is good reason to do everything that the Foundation is doing without Russia a part of the picture."⁵⁴⁸

These differences in opinion aside, members of the SPE Division recognized that what was really at stake was the influence of competition—*perceived or real*—on the Foundation's appropriations. Though the effect was recognized, Weaver suggested the Foundation ought to approach such problems on a higher moral and intellectual level. Building on this, Waterman pointed out that civilizations have always been competitive, and this competition is important in the general strength of the country and its cultural

⁵⁴⁶ Kennedy, John F. As quoted in "Summary of Legislative Proceedings of Particular Interest to the National Science Foundation 87th Congress, 1st Session," 13 November 13, 1961, 1. Hearings FY 1961 + 1962; Box 2, Subject Files, 1951-1962; Records of the National Science Foundation, Subject Files of the Associate Director (Kelly), RG 307; NACP.

⁵⁴⁷ "Draft of Proposed U.S.-U.S.S.R. Comparisons of Scientific and Technical Education and Manpower Study." Undated. Hearings FY 1961 + 1962; Box 2, Subject Files, 1951-1962; Records of the National Science Foundation, Subject Files of the Associate Director (Kelly), RG 307; NACP.

⁵⁴⁸ Minutes of Meeting of Board Scientific Personnel and Education Committee [draft], January 21-22, 1960, 7-8. Division of Scientific Personnel and Education 1960 – general; Box 52; Records of the National Science Foundation, Index Files of the Director, Waterman 1949-1963, RG 307; NACP.

ideology of leadership. Nevertheless, Waterman cautioned the members of the Division that the Foundation must concentrate on quality. Weaver, in what seems like an act of compromise or at least a better articulation of his arguments, brought up the distinction between inspiration and fear, emphasizing that the nation's scientific growth should be based on a sincere desire to advance science, rather than either on fear or competition. Somewhat soberingly, another member reminded the group "that most action on the part of people is based on competition."⁵⁴⁹ Indeed, the pervasive duality of modernization—with its balance of anxiety and optimism—was emerging as an inescapable parameter within which the NSF must work.

The incident described above illuminates an important tension felt throughout the NSF, and throughout much of America more generally. While newspapers and politicians loudly rued the inevitable decline of the nation lest it find solutions to the "math and science crisis" or the "technology gap," the parameters of this crisis (or gap) were as yet undefined. Furthermore, the relationship between research, reform, rhetoric, and resources remained murky. The federal pocketbook would open if a problem of import to national or economic security was presented; funding the reform of American mathematics education could be presented as fitting the bill, but doing so while keeping true to the missions of the NSF was a somewhat trickier task.

Nevertheless, the NSF forged ahead. Four months after the meeting described above, the NSF outlined a concrete plan for improving the nation's math and science instruction, specifically as it compared to programs in other nations. Asking for a budget of \$400,000 for the Course Content Improvement Section of the SPE Division, the NSF proposed to use this funding to continue international curriculum development projects. The stated goal of this work was "to improve the quality of [U.S.] curricula content by providing opportunities for leading American scientists to study the education systems and course materials developed by other nations."⁵⁵⁰ Importantly, however, the NSF left its responsibilities more open than what was implied by the appropriation-friendly language of international comparison aimed at trumping the competitor. Instead, the outlined report proposed a considerable increase in efforts in "curricula and course studies at all levels of the educational system. Additional support should also be provide [sic] for experimental projects to improve supplementary teaching aids and international curriculum development studies."⁵⁵¹

Throughout the early 1960s, federal support of education reform remained strong, both fueled by the Space Race and an increasing interest in domestic issues such as race and poverty. It was these latter issues that the Elementary and Secondary School Act of 1965 was intended to address, though its emphasis on math and science education belies the legislation's Cold War context. By the end of his presidency, Lyndon B. Johnson had overseen federal education efforts aimed at improving math and science education for both the training of highly skilled specialists and also the education of the underserved. Importantly, these efforts were taking place at a federal level and on a broad front; the

⁵⁴⁹ Ibid., 9

⁵⁵⁰ Minutes of the Thirty-Fourth Meeting of the Divisional Committee for Scientific Personnel and Education. May 6-7, 1960, 9. Divisional Committee for Scientific Personnel and Education- 1960 and back; Box 52; Records of the National Science Foundation, Index Files of the Director, Waterman 1949-1963, RG 307; NACP.

⁵⁵¹ Ibid., 3.

federal government entered education reform in a big way, and all within the span of little more than a decade.⁵⁵²

The Aftermath of the New Math: Shifting Rivalries and Reform

Many NSF-funded programs—most notably SMSG but there are a number of other examples—sought to develop curricular materials that would support what was becoming known as the “new math.” The history of the new math and its implementation is outlined in earlier sections of this dissertation, and furthermore is generally well documented. For the purposed at hand, then, it is instructive to look at the context within which the new math, once touted as the hope for America’s future, ultimately came to symbolize its failure in a changing Cold War context.

The ubiquitous calls from national leaders after Sputnik to revitalize math and science—as well as the ties to Cold War politics and the military-industrial complex—clashed with the emerging antiestablishment cultures and conservatism.⁵⁵³ The curriculum that espoused tracking to usher students into “appropriate” course sequences was, some argued, abused in the context of the social and political challenges that emerged throughout the nation. Schools of the 1960s began to be called “shopping mall schools,” with students presumed to be given *too* much choice in creating an individual curriculum in the name of the era’s national hallmarks of individualism, personal freedom, and choice. Altogether, American education reform was increasingly seen by growing numbers of conservatives as a failure led by Big Government. Add to this mix the very real trouble the NSF was finding itself in regarding science and math education in the mid-1970s [See Ch. 3], America (or at least its federal government) was in poor shape to solve the problem it so carefully defined.

Nixon’s first term—colored by a declining economy and an unpopular Vietnam War—saw a sharp uptake in criticism of earlier social policy initiatives and particularly the government’s role in them. Nixon was firmly committed to reducing the government role in these areas.⁵⁵⁴ Education, however, was not entirely removed from government control. Increasingly so during Nixon’s administration schools were facing extraordinary financial pressure. It was determined that the 8 or 9 percent of the local education budget was crucial for school operations. For this reason, even as many began to argue for local autonomy in education, these remained mainly rhetorical, with the federal government maintaining a role in the classroom, including in the development of curricula.⁵⁵⁵

Just as in earlier years, education remained tied to conceptions of national identity. This national identity, however, was changing, and with it came new anxieties that shaped the way Americans thought about the nation and its classrooms. As the Vietnam War dragged on, the economy became an increasingly important marker of American success at home and abroad. The Johnson years saw the deterioration of American productivity and thus competitiveness in the world market. The United States ultimately tumbled into insolvency. In the early 1970s the nation did not have enough gold to back all foreign-held dollars; in 1971 Nixon announced the end of the direct

⁵⁵² J. Myron Atkin, “The Government in the Classroom” *Daedalus* 109:3 (Summer, 1980): 90.

⁵⁵³ David L. Angus and Jeffrey E. Mirel, “Mathematics Enrollments and the Development of the High School in the United States, 1910-1994,” in *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick. (Reston VA: National Council of Teachers of Mathematics, 2003): 448.

⁵⁵⁴ Atkin, “The Government in the Classroom,” 90.

⁵⁵⁵ *Ibid.*, 93.

convertibility of the dollar to gold.⁵⁵⁶ This announcement—along with other measures came to be known as the “Nixon Shock”—was a dramatic indication of the poor state of the economy. Perhaps more devastating to perceptions of national strength, however, was the ways this economic decline affected domestic life, with rising interest rates by the end of the 1970s alongside ballooning budget deficits.⁵⁵⁷ It seemed to many that “the house of cards” was tumbling down after all, and by the 1970s the earlier optimism that drove reform efforts was nearly entirely eclipsed by deep-seated anxiety about the nation.

Part of this anxiety centered on increasing tensions regarding the respective roles of the federal, state, and local government in controlling the purviews—and thus the purse strings—of each sector. Partly, too, rising conservatism in the United States led the basic charges against excesses of Big Government. But the role of federalism in America can alternatively be understood as driven by a rhetoric of crisis and anti-crisis rhetoric. From 1929 to the early 1950s, for example, a series of national crises “shredded the constitutional standards, and the national government became legally free to move into areas once considered the legal preserve of the states.” It was in this milieu that government-centered education reform effort flourished as an activist federal government was generally accepted. Following this period, however, and as education reform efforts unfolded, there was an “uneasy sorting out of roles between the national government and the state-local sector.” By the late 1970s, the uneasy balance between national and state local—paired with a deficit-ridden federal government—shifted much action to the state and local governments, “a shift that would have seemed virtually impossible” during the previous few decades.⁵⁵⁸

The federal government—and thus the NSF—effectively had its hands tied in education reform, although some few examples indicate there continued to be minimal curriculum reform work happening at this level. The reduced role of the federal government, however, could change with the emergence of a new crisis, which could once more unfetter the federal government and allow for its reentry in curriculum reform. The setting for that crisis was in a period of deep uncertainty about the state of the economy, both domestically and in relation to countries that would become foreign rivals. In this context, math education continued to represent a weapon against anxieties about the position of the United States in the world.

By the late 1970s, politicians and policymakers “began to make a stronger connection between the performance of U.S. students on standardized tests and the supposedly imperiled economic future and security of the nation.”⁵⁵⁹ By the early 1980s this relationship took on increased significance, as the U.S. balance of trade and investment shifted in ways that made Americans feel *economically* vulnerable. Prominent American companies were purchased for foreign ownership (RCA, Goodyear, Pillsbury, and National Steel, among others), which led many Americans to fear the U.S. production was given over to foreign control.⁵⁶⁰ Importantly, this fear was readily

⁵⁵⁶ James Chace, “The Age of Anxiety,” *World Policy Journal* 13:3 (Fall, 1996): 115.

⁵⁵⁷ Ibid.

⁵⁵⁸ James Edwin Kee and John Shannon, “The Crisis and Anticrisis Dynamic: Rebalancing the American Federal System” *Public Administration Review* 52:4 (Jul-Aug, 1992): 321, 326-7.

⁵⁵⁹ George Madaus, Marguerite Clarke, and Michael O’Leary, “A Century of Standardized Mathematics Testing,” in *A History of School Mathematics*, vol. 2, edited by George Stanic and Jeremy Kilpatrick. (Reston VA: National Council of Teachers of Mathematics, 2003) 1363.

⁵⁶⁰ C. Christopher Baughn and Attila Yaprak, “Economic Nationalism: Conceptual and Empirical Development,” *Political Psychology* 17:4 (Dec., 1996): 761-762.

blended with existing Cold War fears. As economic aspects of foreign rivalry began to eclipse military concerns, more and more often martial terminology was adopted to describe “commercial international ‘battles’ (‘trade and investment wars,’ ‘siege economy,’ national and regional economic ‘fortresses’).”⁵⁶¹ Clearly, the culture of Cold War anxiety was changing, moving from military and ideological enemies to economic ones. How, though would this shape its relationship to mathematics education?

Even as America’s Cold War anxieties shifted, education—and particularly education in mathematics—continued to be firmly linked to national identity. In 1981, Secretary of Education Terrel H. Bell created the National Commission on Excellence in Education in response to a widespread public perception that the American educational system needed reform. Meanwhile, the media continued to pepper the “crisis” with wartime rhetoric and images of decline. “The weaknesses of the American education system,” one interviewee was reported to say, “have become a national malady that gnaws at our economic strength, our competitive edge in technology and productivity, and our ability to defend ourselves.” A 1984 *Atlantic Monthly* article warned that America must raise its educational effort “in order that the nation may survive and flourish.”⁵⁶² A 1982 *Washington Post* article even went so far as to boldly claim that Americans “can’t compete with a driver of a tank from the Soviet Union who has two years of calculus when we have to write our manuals at the sixth-grade level in comic book style.”⁵⁶³ Though calculus is not often considered a prerequisite for tank driving, the point is clear: America is defenseless if its math skills are not improved.

The pessimism that grew in the late 1970s as the nation experienced a losing war in Vietnam and a crumbling economy created new anxieties among Americans. For a moment, these fears eclipsed the optimism and mobilization to action that so often arises in an effort to drown out nagging anxieties. However shifting anxieties can be addressed by shifting terms of optimism. By the early 1980s this rhetoric of the nation being attacked was reinstated, this time with a stronger focus on economic rivalries to complement the traditional concerns with national security.

The NSF, for its part, recognized the upswing enjoyed by education reform supporters, and reentered the stage with the newly established National Science Board Commission on Precollege Education in Mathematics, Science, and Technology in the early 1980s. This Commission was hailed as one “of the most important and far-reaching activities the Board has undertaken in its thirty-one years.”⁵⁶⁴ Perhaps more illustrative of the perceived importance of this Commission within the NSF comes from a statement of its Director: “I view [finding ways to reverse the decline in precollege education in science and mathematics] as the most important matter I will face during my tenure as

⁵⁶¹ Ibid., 762.

⁵⁶² Curtis C. McKnight, F. Joe Crosswhite, and John A. Dossey, *The Underachieving Curriculum: Assessing U.S. School Mathematics from an International Perspective: A National Report on the Second International Mathematics Study* (Champaign, IL: Stipes Publishing Co., January 1987), 10.

⁵⁶³ Donna Hilts, “Equation for a Teaching Crisis,” *Washington Post, The (DC)*, August 8, 1982.

⁵⁶⁴ Lewis M. Branscomb to Member of the National Science Board Commission on Precollege Education in Mathematics, Science, and Technology (Branscomb to Member NSB Commission), April 22, 1982, 1. NSB Commission on Pre-college Education in Math, Science + Technol. (Development File) [1]; Box 1, Course Content – Development File; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science and Technology, 1965-1982, RG 307; NACP.

Director of NSF.”⁵⁶⁵ Whatever political considerations may have been at play for such a statement to be made aside, it is clear that within the NSF the new Commission was considered a serious component of the Foundation’s programming.

After decades of involvement with math and science education, however, the NSF was in a difficult situation if intending to reclaim responsibilities in areas seen as examples of the Foundation’s previous failures. The letter drafted to the initial members of the Commission recognized the history of debate and discussion, and emphasized the need to develop a *new* understanding of the NSF’s role:

While many persons agree that these problems need to be addressed, there is little consensus on the steps that should be taken or who should take them. In a country where educational policies are developed and implemented by over sixteen thousand separate school districts, improvements are critically dependent upon such a consensus. So too is a viable definition of the role of Federal agencies like the National Science Foundation.⁵⁶⁶

The goal, then, of the Commission was articulated to these members as defining a national agenda for math and science education that carefully outlines the appropriate roles of federal, state, and local governments, as well as the coordinated roles of the private sector and professional and scientific societies. All agents, it was agreed, were to work together in “addressing this problem of national dimension.”⁵⁶⁷

One of the justifications for branding math and science education as a national problem (apart from the historical tendency to do so in the United States) was the familiar story of competition—even if the terms of the competition might shift. Each new member was greeted with the manifesto: “We at the National Science Board believe this to be a cause for serious concern, particularly in light of the very rigorous training in mathematics and science required of all students in Japan, Germany, Russia, and other Eastern bloc countries.”⁵⁶⁸ Despite new competitors in ideology, military, and economics; despite decades of attempts to “solve the problem;” and despite a declining national faith in science and math after innovation and technology failed to win the Vietnam War or improve the economy, improving math education was still touted as the nation’s best defense.

The discussion around mathematics education reform had picked up a few new characteristics, however. One was a clearer articulation of the role of mathematics education as separate from the sciences and engineering. One of the stated criteria to be addressed by the Commission was regarding mathematics—“as the most basic and critical skill for all science and technology related activities, the Commission must be

⁵⁶⁵ John B. Slaughter, “Establishment of the NSB Commission on Precollege Education in Mathematics, Science and Technology,” Staff Memorandum, April 30, 1982. NSB Commission on Pre-college Education in Math, Science + Technol. (Development File) [1]; Box 1, Course Content – Development File; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science and Technology, 1965-1982, RG 307; NACP.

⁵⁶⁶ Branscomb to Member NSB Commission, April 22, 1982, 2.

⁵⁶⁷ Slaughter, “Establishment of the NSB Commission on Precollege Education in Mathematics, Science and Technology.”

⁵⁶⁸ Branscomb to Member NSB Commission April 22, 1982, 2.

able to consider the extent and importance of early mathematics training.”⁵⁶⁹ This does not appear to be merely lip service to complaints from mathematicians working on earlier NSF committees, either. In his introductory letter to Commission members, the chair of the National Science Board, Lewis Branscomb, offers examples to show that “far too many [secondary schools] do not offer the minimum training needed for technical career opportunities.” Crucially, nearly all of the examples chosen point to deficiencies in *math* education, not science:

As an example, only a third of our high school students take mathematics beyond the tenth grade. Only a third of our high schools require more than a single year of mathematics or science for graduation. About a third of our high schools do not offer enough mathematics to qualify a student for admission to engineering without remedial training, and about one third of freshman in engineering colleges must take remedial mathematics. Finally, over ninety percent of the states now report shortages of mathematics teachers at the secondary level, and about a third of secondary science teachers not themselves major in science.⁵⁷⁰

No longer, it seemed, would mathematics universally fall under the “science and mathematics” umbrella in education reform discussion.

Other factors, however, influenced a changing methodology in education reform efforts—one that wrested some control, ultimately, from the federal government throughout the 1980s with no relation to traditional debates over federalism. This influence came from social scientists engaged in evaluation and policy studies, whose work came to undermine belief in top-down models of educational R&D—a term that seemed to be challenged almost immediately upon coinage. These studies showed that earlier education efforts—such as those organized by the NSF—derived more from norms of the university departments that housed involved scholars rather than actual classroom practices. It became increasingly clear that these earlier models failed to take account of real-world complexity and the importance of interaction between research and development.⁵⁷¹

Yet the influence of the anxiety-optimism duality that perhaps most apparently shaped the education reform discourse that was developing in the 1980s. In the early years of the 1980s—a time when America was struggling with a recession—economic competitors joined the specter of potential military foes in a more obvious way. In May of 1982, President Reagan spoke of the relationship between math and science education and the American economy at the National Convocation on Precollege Education in Mathematics and Science. He warned, the “problem is serious enough to compromise America’s future ability to develop and advance our traditional industrial base and to

⁵⁶⁹ NSF. “Commission Membership Criteria.” NSP/PPC-82-3 Addendum. Enclosure in Windus, Margaret L. to Members of the National Science Board, memorandum, “Commission on Precollege Education in Mathematics, Science, and Technology.” NSB Commiss. on Pre-college Education in Math, Sci. + Techn. (Development File) [2]; Box 1, Course Content – Development File; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science and Technology, 1965-1982, RG 307; NACP.

⁵⁷⁰ Branscomb to Member NSM Commission, April 22, 1982, 1.

⁵⁷¹ Ellen Condliffe Lagemann, “Contested Terrain: A History of Education Research in the United States” *Educational Researcher* 26:9 (Dec., 1997): 11.

compete in international marketplaces.”⁵⁷² This statement came, in part, as a result of NSF studies on international comparisons of competitor countries’ economies. One such report, *Science and Engineering Education for the 1980s and Beyond* (1980), included a stark, clear comparison between West Germany, Japan, Great Britain and the United States. Germany and Japan, according to this study, continued to stress science and mathematics training in their secondary schools. Great Britain and the U.S., on the other hand, were reported to be falling behind in the training of students in science, math, and engineering. To emphasize the implications of this “weakness” of America, the following table [Table 7] was included to demonstrate a simple 1:1 correlation between mathematical training and economic benefit:⁵⁷³

	<i>Share of World Trade</i>	<i>Engineering Graduates As A Proportion of Relevant Age Group</i>	
	1963	1977	(1977-78)
United Kingdom.....	15%	9%	1.7%
W. Germany.....	20%	21%	2.3%
Japan.....	8%	15%	4.2%
United States.....	21%	16%	1.6%

Table 7

Lest the reader remain unconvinced, the report continued: “Between the same years (1963-1977) productivity increased in the manufacturing industries of the United Kingdom, West Germany, Japan, and the U.S. (using 1963 as the base year) by 51 percent, 114 percent, 197 percent, and 39 percent, respectively.”⁵⁷⁴ Suddenly, America was becoming uneasy about its perceived educational decline, this time not as a result of a small Russian satellite, but rather by the Toyotas on our streets and Toshiba’s in our living rooms.⁵⁷⁵ Though the direct link between economic productivity and math education was clouded, the implication was as clear as in the example of the Russian tank driver: a solid mathematics education might not be directly linked to car production or tank driving, but nevertheless it was the underlying skill that you need to get ahead.

Anxiety about the relationship between the nation’s economic decline and American educational decline were a growing number of testing programs that became a popular form of data collection on mathematics education in the 1980s. Such studies were

⁵⁷² “Summary: Perspective on the Problem—An Overview” National Convocation on Precollege Education in Mathematics and Science, Washington D.C., May 12-13, 1982, 5. NSB Commiss. on Pre-college Education in Math, Science + Techn. (1st Operational File) [3]; Box 2, Development File – 1st Operational file; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science and Technology, 1965-1982, RG 307; NACP.

⁵⁷³ National Science Foundation and the Department of Education (NSF and DoE), “Staff Analysis,” *Science and Engineering Education for the 1980’s and Beyond*, October, 1980, 58. NSB Commission on Pre-college Education in Math, Science + Technol. (Development File) [1]; Box 1, Course Content – Development File; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science and Technology, 1965-1982, RG 307; NACP.

⁵⁷⁴ Ibid.

⁵⁷⁵ NSB Commission on Precollege Education in Mathematics, Science and Technology, “Resource Document: Introduction” [Draft], June 10, 1983, 7. NSB Commiss. on Precollege Education in Math, Science + Technol. Newspaper, Memos, booklet; Box 4, ‘Educating Americans’ – Follow up history; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science and Technology, 1965-1982, RG 307; NACP.

viewed as a way to both remedy education and combat the perceived economic woes of the country [See Ch. 4]. Test results on standard exams were compared, nation by nation; just as America saw East Asia—Japan in particular—as a growing economic threat, these reports painted Japanese students as dangerously superior:

The International Project for the Evaluation of Education Achievement ranked Japanese 13-year-olds highest in mathematical achievement among 12 countries including the U.S. and several European countries. Japanese students were also the most positive in their liking for mathematics.⁵⁷⁶

The link, though tenuous at best, was clearly implied: our biggest foreign (economic) rival boasted better math scores among its school-aged children. If the United States could only improve its mathematics education the nation would no doubt achieve economic supremacy. Report after report, the results were the same: American students underperformed, and if the United States hopes to retain global dominance, something needed to change.

Many of the countries surveyed in such international studies had a system of national mathematics standards. As the United States has always had a non-uniform educational system, with school legislation occurring first at the local level, it was clear that implementing such national standards would face political opposition. Nevertheless, in the wake of such studies many argued that reform of mathematics education required *voluntary* local implementation of common *national* standards. This kind of mobilization of disparate school systems—a new optimism on a grand scale—would require a collective national anxiety, perhaps one akin to the era of “Sputnik fever.”

Without a Russian satellite in orbit, the crisis came in the form of the 1983 report, *A Nation at Risk*. Becoming known as the “mother of all critiques” of American education, this report ushered in renewed arguments for more federal involvement in education, but this time with the aim of creating higher content standards and then aligning the curriculum to support those standards.⁵⁷⁷ *A Nation at Risk* dripped with nationalistic rhetoric, calling for educated citizens who could “participate fully in our national life” and bringing a high level of shared education to “a country that prides itself on pluralism and individual freedom.”⁵⁷⁸ Throughout the text, “Nation” is capitalized for emphasis. The sense of crisis and competition is evoked on the Report’s opening page: “If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might well have viewed it as an act of war.”⁵⁷⁹ America responded to having its anxieties so blatantly piqued and clearly defined. Only four months after the release of *A Nation At Risk*, more than 700 articles in 45 newspapers mentioned the report, and just a year after the NSF education directorate was abolished, Congress granted the Foundation funding to increase efforts in improving math and science programs.⁵⁸⁰ Leaders in Washington were urged to promote action over

⁵⁷⁶ NSF and DoE, “Staff Analysis,” 58.

⁵⁷⁷ Lappan and Wanko, “The Changing Roles and Priorities of the Federal Government in Mathematics Education in the United States,” 916.

⁵⁷⁸ McKnight, Crosswhite, and Dossey, *The Underachieving Curriculum*, 2, 58.

⁵⁷⁹ Madaus, Clarke, and O’Leary, “A Century of Standardized Mathematics Testing,” 1363.

⁵⁸⁰ Maris Vinovskis, *From A Nation at Risk to No Child Left Behind: national education goals and the creation of federal education policy* (New York: Teachers College Press, 2009), 17.

fact-collection. In a hearing before the House of Representatives, politicians were reminded, “There *already* is ample evidence of what the problems are and what is needed to solve them. The problems are not solved by additional studies. What is needed is federal *action* to address documented serious national problems.”⁵⁸¹

A Nation at Risk spurred meetings tasked with determining the concrete path America was to take in improving mathematics education. In November 1983, a meeting sponsored by the NSF and organized by two members of the Conference Board of the Mathematical Sciences led to the explicit recommendation that NCTM should prepare a set of standards and there should be an establishment of the Mathematical Sciences Education Board. The next important meeting was at the University of Wisconsin in December of the same year. This meeting, too, called for the drafting of national standards.⁵⁸² By the mid-1980s a consensus was forming that the only way to lead America out of this crisis was to develop—and uphold—national standards. Once again, national identity came to be defined, in this case almost literally, by measures in mathematics education.

At the close of the 1980s, one more important document was released. The National Research Council, through its Mathematics Sciences Education Board, published *Everybody Counts*, with the subtitle: *A Report to the Nation on the Future of Mathematics Education.* *Everybody Counts* argued, familiarly, a link between the decline in student achievement in mathematics with the decline in the competitiveness of the U.S. economy. As the evidence for this argument is at best correlational, the idea that improving mathematics education will *consequently* improve the U.S. economy is an argument meant to appeal to politicians more than to the education profession. *Everybody Counts* was a political document, written by an influential body and was intended for policymakers, industrial leaders, politicians, and people with local educational influence.⁵⁸³ The arguments are clear, the facts appear undisputed through quotations and simple statistical graphs, and the logic is a simple cause and effect model. *Everybody Counts* plants the seeds of anxiety and presents an obvious problem with a solution: standards.⁵⁸⁴ Without these, it is argued in the text, it has been difficult to discuss curricula in meaningful and productive contexts.⁵⁸⁵

Everybody Counts spared no use of anxiety to motivate preemptive action amongst its readers. The opening page grabs attention: “Wake up America! Your Children are at risk!”⁵⁸⁶ Mathematical illiteracy is referred to as “both a personal loss and

⁵⁸¹ Sarah E. Klein, “Testimony to Subcommittee on Science, Research and Technology of the Committee on Science and Technology of the United States House of Representatives in regard to 1983 Authorization for the Science Education Component of the National Science Foundation” February 25, 1982, 2. NSB Commiss. on Pre-college Education in Math, Science + Tech (1st Operational File) [2]; Box 2, Development File – 1st Operational file; Records of the National Science Foundation, Records Relating to the Commission on Precollege Education in Mathematics, Science and Technology, 1965-1982, RG 307; NACP.

⁵⁸² Douglas B. McLeod, “From Consensus to Controversy: The Story of the NCTM *Standards*,” in *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick. (Reston VA: National Council of Teachers of Mathematics, 2003): 766-767.

⁵⁸³ Alan J. Bishop, “Mathematical Power to the People,” in *Critical issues in Mathematics Education: major contributions of Alan Bishop*, edited by Philip Clarkson and Norma Presmeg, (New York: Springer, 2008), 157, 151-153.

⁵⁸⁴ *Ibid.*, 153.

⁵⁸⁵ *Ibid.*, 154.

⁵⁸⁶ Committee on the Mathematical Sciences in the Year 2000, National Research Council (U.S.), *Everybody Counts: a report to the nation on the future of mathematics education* (Washington D.C.: National Academy Press, 1989), 1.

a national debt,” and its social and political consequences are reported to “provide alarming signals for the survival of democracy in America... Unless corrected, innumeracy and illiteracy will drive America apart.”⁵⁸⁷ Patriotic language drives the eighty-six-page text, with the word “nation” appearing 132 times, “America” or “American” 69 times, and “U.S.” or “United States” 248 times. If the above terms are lumped together, at least one of these terms shows up, on average, 5.2 times per page. (For reference, the ubiquitous “and” shows up just less than twice that amount, and “education” or “educate” show up less than half as frequently; on average, 2.5 times per page.) Though ostensibly a document about education, one begins to wonder if math education is actually a stand-in for defining a national identity. Indeed, the solution to the problem put forth in *Everybody Counts* is clearly stated in large, block letters of inset text: “America needs to reach consensus on national standards for school mathematics.”⁵⁸⁸ The stage was set. What came next were the standards.

Aiming for National Standards

1989 saw the publication of the NCTM *Curriculum and Evaluation Standards*, which was released to unprecedented excitement within the education community, government officials, and the American public. *Standards* was what everyone seemed to be waiting for. A summary of the document distributed to members of Congress, governors, university administrators and mathematics department chairs, school principals, PTA presidents, and school board chairs. Flyers were prepared for teachers, parents, policy makers and a general audience. A public relations firm was hired to promote the *Standards*’ release, and a video was produced that included Wynton Marsalis explaining the importance of mathematics and the NCTM *Standards* in particular.⁵⁸⁹ The view expressed in this document was that mathematics education plays a role in “maintaining our system of government” and keeps American citizens “competitive at an international level.”⁵⁹⁰

Though the *Standards* did not serve as an official national guideline, nearly all subsequent mathematics curriculum reform efforts were aligned to it. In September 1989, governors from across the nation met to set a challenge for the new millennium: American children should top the world in math and science by the year 2000.⁵⁹¹ A reporter commenting on the event in the *Baltimore Sun* wrote: “I can’t shake the image of 50 governors waving those huge foam plastic fingers in the air, jumping up and down, shouting ‘We’re Number One!’”⁵⁹² While that exact scenario likely did not occur, the optimistic fervor implied by that reporter was nearly tangible.

⁵⁸⁷ Ibid., 14.

⁵⁸⁸ Ibid., 45-46.

⁵⁸⁹ Gail Burrill and National Council of Teachers of Mathematics, Center for Science, Mathematics, and Engineering Education. *Improving Student Learning in Mathematics and Science: the role of national standards in state policy* (Washington DC: National Academy Press, 1997), 10.

⁵⁹⁰ Ole Skovsmose and Paola Valero, “Breaking Political Neutrality: The Critical Engagement of Mathematics Education with Democracy.” In Bill Atweh, *Sociocultural research on mathematics education : an international perspective* (Mahwah N.J.: Lawrence Erlbaum Associates, 2001), 38, 40.

⁵⁹¹ Jo Boaler, *What’s Math Got to Do with It?: helping children learn to love their most hated subject--and why it’s important for America*, (New York: Viking, 2008), 4.

⁵⁹² Lester A. Picker, “SCIENCE, MATH ILLITERATES - U.S. is near bottom of the heap in schooling its youth,” *Sun, The* (Baltimore, MD), April 29, 1991, FINAL edition.

Yet the interconnectedness of math education reform efforts and national identity requires a particular context for mobilization, vastly increased federal influence, and sweeping change. By the early 1990s the Cold War was coming to an end, paving the way for economic concerns to trump national security in the laundry list of national concerns. But the U.S. economy was sharply, with the deficit far reduced—at its lowest in dollar terms since 1981. The military budget accounted for less than 4 percent of GDP in 1996 yet America was felt to enjoy a global military dominance. The U.S. inflation rate, too, was lower than it had been for over a generation.⁵⁹³ In this context a *new* conception of modernization reemerged with a sense that modernity went global—that there is a single, interconnected, and ideologically unified modernity that, as luck might have it, looks very much like the United States.⁵⁹⁴ Looking back to the 1950s, the economic and militaristic success of the United States bolstered the sense that America was “getting it right.” As the Cold War ended and apparent economic success—or relative decline of other countries such as China, Japan, and the Soviet Union—in the 1990s arose, so too did a sense of American-style modernity being the dominant model. And just as in the 1950s technology was seen to be the key to this success, to the “better modernity,” the 1990s championed technology as well—this time of the information kind. Information technology, understood as the backbone of the strong American economy, was touted as the driving force of human history and carried with it the ability to offer technocratic solutions that were value neutral or “above politics.”⁵⁹⁵

The common thread of technology—information or otherwise—as the driving force of modernization firmly situates math and science education as a crucially important. Yet this explanation alone is not enough to describe the nuances of the United States’ half century of efforts at precollege math education reform. Instead we must look deeper at the ways in which modernization fundamentally *changed* between the 1950s and the 1990s. Indeed, the function and rationale of modernization theory in political rhetoric remains somewhat constant in this period, yet the substance and content of modernization fundamentally changes. Whereas in the 1950s modernity symbolized a sort of New-Deal-esque interest in collective action to achieve progress—and a reliance on the state to provide it—the new modernity of the 1990s symbolized the benefit of deregulation, relying instead on the role of the economic market.⁵⁹⁶

With a renewal of faith in modernization in place, what then was the 1990s equivalent to the growing anxieties that helped foment large-scale curriculum reform at the federal level? By the 1990s the American economy seemed to have returned to “that apparently tranquil world of the 1950s and early 1960s, when American economic power was able to undergird the social changes that were about to take place.” However, as historian James Chace argues, rather than embracing a sense of tranquility, “America seems beset by a deep and growing anxiety over what it is becoming.” Chace attributes this to an ever-widening income gap, the stagnation of wages, and the inflating costs of entitlement that accompanied the nation’s economic growth.⁵⁹⁷ Just as in the 1950s, America demonstrated a combination of anxiety and a denial that anxiety that looked to

⁵⁹³ Chace, “The Age of Anxiety,” 115-116.

⁵⁹⁴ Gilman, *Mandarins of the Future*, 270.

⁵⁹⁵ *Ibid.*

⁵⁹⁶ *Ibid.*, 271.

⁵⁹⁷ Chace, “The Age of Anxiety,” 116.

many as one again “shouting to the world how great we are”—perhaps this time waving huge foam plastic fingers in the air.

The *Standards* offered the inroad to modernizations rational approaches to reform and national supremacy, while at the same time redefining a nation beset with anxieties about its role in the world. Nearly immediately following its publication, a rash of policy initiatives aimed at improving American mathematics education before the turn of the 21st century were put forth. In his January 1990 State of the Union Address, President George H. W. Bush made the chest-thumping, foam finger waving ultimatum: “By the year 2000, U.S. students much be the first in the world in math and science achievement.”⁵⁹⁸ Here, with no external enemy apparent to threaten the cohesion of the nation, the new enemy appeared to be time, which was quickly ticking toward the millennium.

This optimistic challenge for the nation and the embrace of a race against time was supported through a string of legislation. *AMERICA 2000: An Education Strategy*, published in 1991 by the U.S. Department of Education, used conspicuously patriotic metaphors, as did *Goals 2000: Educate America Act*, which was signed into law in 1994. *AMERICA 2000* introduced six goals, and *Goals 2000* added an additional two, although one interesting rewording appears in Goal 3 of the 1994 Report. In *AMERICA 2000*, Goal 3 reads “[students] may be prepared for...productive employment in our modern economy,” yet the 1994 version reads: “[students] may be prepared for...productive employment in our *Nation’s* modern economy.”⁵⁹⁹ A small change, perhaps, but one that speaks to the need to specify the goals of improving the *American* economy rather than a global one; even as modernization championed a pan-global economy, America still sought to be the preeminent model for how other nations should strive to emulate. *Goals 2000* tasks America to “lead all other nations,” in a spirit of national rather than international aspirations, and driven by political and competitive principles rather than educational and cooperative ones.

With the Space Race neatly supplanted by this race against time, and with optimism securely keeping anxieties “hidden in plain sight,” the stage was set for the unfettering of the federal government, allowing it to reenter education reform in a big way. The move toward developing national standards in mathematics education provided the perfect opportunity. With the passage of *Goals 2000* and the 1994 reauthorization of ESEA—known as the *Improving America’s Schools Act* (IASA)—local school districts and states were federally required to develop content and performance standards, assessment methods, and accountability systems to identify underperforming schools. Though this maintained some autonomy for the state and local jurisdiction, the funding for the program came from the federal government. Importantly, the assessment of educational efficacy came in the form of widespread testing practices throughout the K-12 curriculum. Here, again, mathematics played a central role as it was stable throughout the curriculum and could be relatively easily tested across diverse school populations. This, however, was in essence *just* data-collection—requiring standards and detailed testing schemes provided information about schools, but absent from the legislation was

⁵⁹⁸ Vena M. Long, “The Role of State Government in the Custody Battle over Mathematics Education,” in *A History of School Mathematics*, vol. 2, edited by George Stanic and Jeremy Kilpatrick, (Reston VA: National Council of Teachers of Mathematics, 2003): 947.

⁵⁹⁹ Marie Thorsten, “Once Upon a TIMSS: American and Japanese Narrations of the Third International Mathematics and Science Study,” *Education and Society* 18:3, (2000): 58.

an effort to make improvements. This would come only with the 2002 passage of No Child Left Behind, legislation that fundamentally shifted the federal government's involvement in education. All, of course, in the name of improving American education, sustaining a productive knowledge-based economy, improving national security, and producing more math- and science- literate student than any competitor nations.

Conclusion: Is America Across the Finish Line?

War, crises, and enemies have always helped unify nations, and American policy makers have aimed to cast education in those terms.⁶⁰⁰ Mathematics, more than any other subject, has been used to define the terms of this war, and in no uncertain terms. James Rutherford, involved in math and science education reform through the U.S. Department of Education, the NSF, and the AAAS, said of improving math education: "It will take an all-out national effort. But this is a war that can and must be won." Newspaper reports mirror this urgency; one Ohio newspaper stated: "If anyone knows the definitive answer as to why American eighth-graders score below the world average in math - behind such countries as Singapore, Slovenia and Bulgaria - please contact the U.S. Department of Education immediately. You'll be a national hero."⁶⁰¹ While this is perhaps a bit tongue-in-cheek, Americans leaders undoubtedly tend to conflate education with symbols of national pride and international economic competitiveness.⁶⁰²

As the Cold War era competitions shifted toward economic ones, the United States became increasingly concerned with its comparison with Asian powers, namely its economic "war" with Japan. Mathematics education standards played a crucial role in developing this fervor. Seemingly objective tests of math abilities across countries "proved" to some that Japan was positioning itself to take leadership in the global marketplace. In short, mathematical abilities measured national success. This global arms race in education was perpetuated by a number of the same sorts of studies undertaken in the 1980s. These studies showed systematic differences in achievement and practice between East Asian countries and the United States, spurring an increasing interest for policy makers and educators to allow government responsibility for economic failure to be passed on to education.

Educationist J. Myron Atkin places the role of the government in education in context, arguing that involvement will be spurred by responding to a national consensus, if it emerges, "about some issue that suddenly seems clear to the American public because of unanticipated crisis." He goes on to say that we are unlikely to see professionals determining the proper role of the federal government in education, and this will simply happen as a result of politicians responding to pressures from the electorate and the courts. Writing in 1980, he says (presciently?) that this will occur against a backdrop of economic decline.⁶⁰³ Atkins's commentary remains laced with pessimism, as he predicts continued decline in student achievement and educational quality. He doesn't, however, blame government inadequacy or ineptness on the part of educators, at least not directly. Instead he considers these declines to be influenced primary by political, economic, demographic, and cultural factors. The federal government, of course, is rarely

⁶⁰⁰ Thorsten, "Once Upon a TIMSS," 61.

⁶⁰¹ "Adding Up Average - U.S. Needs Marshall Plan on Math Education," *The Columbus Dispatch*, (OH), December 3, 1996, Home Final edition.

⁶⁰² Thorsten, "Once Upon a TIMSS," 46.

⁶⁰³ Atkin, "The Government in the Classroom," 96.

blind to these factors, yet Atkin charges the frequent impotence it has in dealing with these broader issues leads the federal government to focus “with irritation and frustration on the schools.”⁶⁰⁴

If Atkin is right in his charge, mathematics education reform at the federal cannot be understood without contextualizing the sociopolitical backdrop in which it unfolds. As this chapter demonstrates, the interdependence of national anxiety and active optimism in the potential of reform makes a history of math curricula improvement efforts at the federal level a more complicated narrative beset with Cold War fears and domestic concerns. But nagging questions remain: why did the nation seemingly *unquestioningly* look toward improving K-12 mathematics education when addressing issues of national security, social upheaval, or economic competition? And why, with a history of failures in federal reform efforts—perceived or otherwise—widely understood, and a nation far from free of anxieties, is math education reform *still* touted as a solution?

In the early Cold War context, the tendency to address societal problems and national anxieties with efforts in improving precollege math curricula is twofold. One, the relationship between mathematics and the nation has historically been taken for granted, with mathematics education tasked with responding to—and healing—social and economic problems of the nation. The tendency to propagate this assumption is referred to as internalism, where an intrinsic resonance is *presumed* to exist between mathematics education and democracy, and therefore is not specifically addressed in research.⁶⁰⁵ This—along with the more general faith in scientific approaches to problem solving championed by modernization theory—allowed early reformers to act within a Cold War backdrop of near unanimity that math training was directly related to the well being, security, and preeminence of the nation. Secondly, the tendency to turn toward math education comes in the structure of the NSF itself. As an arm of the federal government charged with, primarily, the support of basic research, efforts in education reform *necessarily* were organized around groups of university-based experts. As the nation sought improvement in the quality of precollege math and science education in the name of Cold War concerns, control in this area was sent to the NSF where it was removed from other areas of education. This isolation likely contributed to a distinct failure to ask if alternative approaches to improving math education might be more successful—the NSF’s internal structure made the expert-driven, research-based, educational R&D the only available model. Fears about the excesses or even the undemocratic nature of expert authority did not generally concern these reformers, according to historian Jessica Wang. These figures, in the context of modernization and Cold War anxieties:

Assumed that the obvious advantages to be gained through the objective application of scientific approaches to policy-making would easily earn vigorous popular assent. That their interests and value-laden assumptions might sway their decisions and that their proposed solutions to social and economic problems might prove as controversial as those arrived at through normal political processes, rarely occurred to them.⁶⁰⁶

⁶⁰⁴ Ibid., 97.

⁶⁰⁵ Skovsmose and Valero, “Breaking Political Neutrality,” 40-41.

⁶⁰⁶ Wang, “Liberals, the Progressive Left, and the Political Economy of Postwar American Science,” 154-155.

Notably, the vigorous popular assent predicted by NSF-funded experts did indeed follow. It was generally assumed that these new curriculum developers had goals identical to the general population—which included the vanquishing of Cold War anxieties—as well as the goals of educators and administrators. The degree that such assumptions were well founded within society led to very little questioning of the mechanism for education reform.⁶⁰⁷ It was in this climate, then, that federal curriculum reform activities seemed so uncontroversial, so reasonable, and ultimately so *normal* that the intrusion of the federal government into the classroom beginning in the 1950s seemed natural.⁶⁰⁸ By the time Cold War anxieties shifted enough to pull away the curtain, the federal government was firmly entrenched in math and science education reform, ready to step in when national anxieties converged and ultimately provide the conditions for overt federal action; time and time again these solutions led the government to “focus with irritation and frustration on the schools.”

Mathematics education offered a convenient entry for this focus throughout the second half of the twentieth century. Firmly associated with social issues since the 1800s, precollege education took on a new importance as scientific and technological skill was seen to vault the nation to international supremacy following a victory in World War II. Maintaining this preeminence took on new urgency as the Cold War developed, with mathematics education reform a veil to shade anxieties and nagging doubt about the strength of the nation. The doubt ultimately triumphed, however, with the perception of failed domestic policies—including those in education reform—shifting Cold War anxieties inward. For a brief moment these anxieties eclipsed action, however action-producing optimism reemerged with forceful warnings that the previous few decades left the nation dangerously at risk. To be prepared, it was familiarly argued, the nation must support and improve quality precollege math and science education. Increasingly, as the nation’s concerns over its global economic position intensified, math education was championed as a key component in the development of a productive technocracy, seen as the path of the future. By the 1990s, with the Cold War disbanded and the U.S. economy thriving, a new modernization helped direct increased federal influence in math education reform, led by the push to develop national mathematics standards by which international comparisons could be made and rivalries measured.

* * * * *

Harry Angstrom, a character in John Updike’s 1990 novel, *Rabbit at Rest*, commented: “Without the Cold War, what’s the point of being an American?”⁶⁰⁹ Indeed, the Cold War structured the very nature of what it meant to be American. Throughout this tumultuous period the nation sought to define itself, to find a common national identity, and secure a position in an ever-changing world. In some irony it was exactly by these efforts, strewn across nearly all areas of American life, that America could most readily be defined. Had Angstrom had different interests he could well have asked a similar question: “Without the Cold War, what’s the point of reforming math?” Of course, just as being American before the Cold War can be well argued to have inherent purpose, so too is it

⁶⁰⁷ Atkin, “The Government in the Classroom,” 89.

⁶⁰⁸ Ibid., 96.

⁶⁰⁹ Whitfield, *The Culture of the Cold War*, 231.

inappropriate to subject all pre-Cold War reform as unimportant or ineffective. But Angstrom's point is ultimately as salient when considering mathematics education as it is to being American; the Cold War structured the very nature of what math education represented, what potentials it held to combat the anxieties of the age, and how best to reform it in a way that wholly reflected America. It was through the Cold War, through wrestling with the tumultuous fears and anxieties that emerged and shifted, and focused on this one area of American life, that mathematics education reform in the nation was defined.

BIBLIOGRAPHY

ARCHIVAL MATERIALS

National Archives at College Park, MD

Record Group 307

Records of the National Science Foundation

Index Files of the Director

NSF Agency Historians File

Subject Files, 1951-1962

National Science Board

Office of the Director, Subject Files

ORAL HISTORIES

Herbert, James C. *Work in K-12 Education Reform: Student Competencies, Curriculum Assessment, and the Language of Reform*. Typescript of an oral history conducted 2012 by Emily Redman. Regional Oral History Office, The Bancroft Library, University of California, Berkeley, 2012, 59 pp.

Kilpatrick, Jeremy. Typescript of an oral history conducted May 24, 1999 by Dave L. Roberts at University of Georgia. National Council of Teachers of Mathematics Oral History Project. Archives of the American Mathematical Association, University of Texas at Austin, 2001, 80 pp.

Meserve, Bruce. Typescript of an oral history conducted April 3, 2003 by Dave L. Roberts at the home of Dr. Meserve, Green Valley, Arizona. National Council of Teachers of Mathematics Oral History Project. Archives of the American Mathematical Association, University of Texas at Austin, 2003, 77 pp.

Rosenbloom, Paul C. Typescript of an oral history conducted November 15, 20 and December 6, 11, and 13, 2000 by Dave L. Roberts via telephone. National Council of Teachers of Mathematics Oral History Project. Archives of the American Mathematical Association, University of Texas at Austin, 2003, 114 pp.

Suppes, Patrick. Typescript of an oral history conducted April 19, 1999 by Dave L. Roberts at Stanford University. National Council of Teachers of Mathematics Oral History Project. Archives of the American Mathematical Association, University of Texas at Austin, 2001, 39 pp.

Wilson, James. Typescript of an oral history conducted May 24, 1999 by Dave L. Roberts at University of Georgia. National Council of Teachers of Mathematics Oral History Project. Archives of the American Mathematical Association, University of Texas at Austin, 2001, 80 pp.

POLICY DOCUMENTS

“Chapter 1: Director’s Overview.” National Science Foundation Annual Report 1991, NSF 92-1, October 5, 1992. Accessed at <http://www.nsf.gov/pubs/stis1992/nsf921/nsf921.txt>

“Chapter 3: Education and Outreach.” National Science Foundation Annual Report 1991, NSF 92-1, October 5, 1992. Accessed at <http://www.nsf.gov/pubs/stis1992/nsf921/nsf921.txt>

“Chapter 6: Awards and Organizational News.” National Science Foundation Annual Report 1991, NSF 92-1, October 5, 1992. Accessed at <http://www.nsf.gov/pubs/stis1992/nsf921/nsf921.txt>

Committee on the Mathematical Sciences in the Year 2000, National Research Council (U.S.). *Everybody Counts: a report to the nation on the future of mathematics education*. Washington D.C.: National Academy Press, 1989.

The Department of Education Organization Act, 1979, Pub. L. No. 96-88, 96th Congress, October 17, 1979. Accessed at: <http://federaleducationpolicy.wordpress.com/2011/04/15/department-of-education-organization-act-1979/>.

National Committee on Mathematical Requirements. *The Reorganization of Mathematics in Secondary Education*. Washington, DC: The Mathematical Association of America, 1923.

National Council of Teachers of Mathematics. *An Agenda For Action: Recommendations for School Mathematics of the 1980s*. Reston, VA: NCTM, 1980.

National Council of Teachers of Mathematics. *Curriculum and Evaluation Standards for School Mathematics*. Reston, VA: NCTM, 1989.

The National Council of Teachers of Mathematics. *Emerging Practices in Mathematics Education: The Twenty-Second Yearbook*. New York: AMS Reprint Company, 1966 (reprint).

National Council of Teachers of Mathematics. *Principles and Standards for School Mathematics*. Reston, VA: NCTM, 1995.

National Council of Teachers of Mathematics. *Priorities in School Mathematics: Executive Summary of the PRISM Project*. Reston, VA: NCTM, 1991.

National Science Foundation. Instructional Materials Development Program, NSF 96-61, 1996. Accessed at <http://www.nsf.gov/pubs/stis1996/nsf9661/nsf9661.txt?org=NSF>.

National Science Foundation. *The Learning Curve: what we are discovering about U.S. science and mathematics education*. Washington, DC: NSF, 1996.

National Science Foundation. "Management's Discussion and Analysis," *FY1998 Accountability Report*, 1999. Accessed at:
<http://www.nsf.gov/pubs/1999/nsf99114/nsf99114.pdf>.

National Science Foundation, "A Message From NSF Director Rita R. Colwell." The Promise of Science and Engineering: An Investment in the Future: 1996-1997 Annual Report, NSF 98-1, 1998. Accessed at
<http://www.nsf.gov/about/history/nsf981/main.htm>

"Steady State, Steady Strain." *The National Science Board: A History in Highlights 1950-2000*. Accessed at:
<http://www.nsf.gov/nsb/documents/2000/nsb00215/nsb50/1970/macros.html>.

ARTICLES AND CHAPTERS

"Adding Up Average – U.S. Needs Marshall Plan on Math Education." *The Columbus Dispatch*, (OH), December 3, 1996, Home Final edition.

Aichele, Douglas B. "Historical Overview." In *Mathematics Education in Secondary Schools and Two-year Colleges: a source book*, edited by Paul Campbell and Louise Grinstein. New York: Garland Pub., 1988.

Angus, David L. and Jeffrey E. Mirel. "Mathematics Enrollments and the Development of the High School in the United States, 1910-1994." In *A History of School Mathematics* vol. 1, edited by George Stanic and Jeremy Kilpatrick, 493-519. Reston VA: National Council of Teachers of Mathematics, 2003.

Atkin, J. Myron. "The Government in the Classroom." *Daedalus* 109:3 (Summer, 1980): 85-98.

Ball, Deborah Loewenberg. "Implementing the NCTM Standards: Hopes and Hurdles," prepared for a conference on Telecommunications as a Tool for Educational Reform: Implementing the NCTM Standards, December 2-3, 1991, Aspen Institute, Wye Conference Center, Queenstown, Maryland, 3, 15. Accessed at:
<http://ncrtl.msu.edu/http/ipapers/html/pdf/ip922.pdf>.

Baughn, C. Christopher and Attila Yaprak. "Economic Nationalism: Conceptual and Empirical Development." *Political Psychology* 17:4 (Dec., 1996): 759-778.

- Betz, H. E. "A Summary of Some Scientific Investigations of the Teaching of High School Mathematics." In The National Council of Teachers of Mathematics. *The Eighth Yearbook: The Teaching of Mathematics in the Secondary School*, 55-164. New York: AMS Reprint Company, 1966 (reprint).
- Bishop, Alan J. "Mathematical Power to the People." In *Critical issues in Mathematics Education: major contributions of Alan Bishop*, edited by Philip Clarkson and Norma Presmeg, 151-165. New York: Springer, 2008.
- Brown, William. "An Objective Study of Mathematical Intelligence." *Biometrika* 7:3. (1910): 352-363.
- Burrill, Gail. "National Council of Teachers of Mathematics: Changes in Your Classroom: From the Past to the Present to the Future." *Mathematics Teaching in the Middle School* 4:3 (November-December 1989), 184-190.
- Burrill, Gail. "The NCTM Standards: Eight Years Later." *School Science and Mathematics* 97:6 (October 1997): 335-339.
- Buswell, G. T. "Curriculum Problems in Arithmetic." In The National Council of Teachers of Mathematics. *The Second Yearbook: Curriculum Problems in Teaching Mathematics*, 73-93. New York: AMS Reprint Company, 1966 (reprint).
- Cahen, Leonard S. "An interim report on the national longitudinal study of mathematical abilities." *The Mathematics Teacher* 56:6 (October 1965): 522-527.
- Carlton, Charlotte. "Providing a Differentiated Curriculum Through New Organization of Content." In The National Council of Teachers of Mathematics. *Emerging Practices in Mathematics Education: The Twenty-Second Yearbook*, 2-8. New York: AMS Reprint Company, 1966 (reprint).
- Carter, Dan T. "The Rise of Conservatism since World War II." *OAH Magazine of History* 17:2 (Jan. 2003): 11-16.
- Chace, James. "The Age of Anxiety." *World Policy Journal* 13:3 (Fall, 1996): 115-116.
- Citrin, Jack, Ernst B. Haas, Christopher Muste, and Beth Reingold. "Is American Nationalism Changing? Implications for Foreign Policy." *International Studies Quarterly* 38:1 (Mar 1994): 1-31.
- Davis, Robert B. "Changing School Mathematics." In *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick, 623-646. Reston VA: National Council of Teachers of Mathematics, 2003.

- DeVault, M. Vere and J. Fred Weaver. "Designing a Contemporary Elementary School Program: 1952-Present." In *The National Council of Teachers of Mathematics. A History of Mathematics Education in the United States and Canada: The Thirty-Second Yearbook*, 133-154. Washington, DC: National Council of Teachers of Mathematics, 1970.
- Donoghue, Eileen F. "The Emergence of a Profession: Mathematics Education in the United States, 1890-1920." In *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick, 159-194. Reston VA: National Council of Teachers of Mathematics, 2003.
- Dossey, John A. "Large Scale Assessments: National and International." In *A History of School Mathematics*, vol. 2, edited by George Stanic and Jeremy Kilpatrick, 1435-1487. Reston VA: National Council of Teachers of Mathematics, 2003.
- Dow, Peter B. "MACOS: Social Studies in Crisis." *Educational Leadership* 34:1 (October 1976): 35-39.
- England, J. Merton. "The National Science Foundation and Curriculum Reform: A Problem of Stewardship." *The Public Historian* 11, no. 2 (Spring 1989): 23-36.
- Evans, Ronald W. "National Security Trumps Social Progress: The Ear of the New Social Studies in Retrospect." *The New Social Studies: People, Projects, and Perspectives*, edited by Barbara Slater Stern, 1-40. Information Age Publishing, 2010.
- Fey, James T. and Anna O. Graeber. "From the New Math to the *Agenda for Action*." In *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick, 493-519. Reston VA: National Council of Teachers of Mathematics, 2003.
- Garrett, Alan W. and O.L. Davis, Jr. "A Time of Uncertainty and Change: School Mathematics from World War II until the New Math." In *A History of School Mathematics* vol. 1, edited by George Stanic and Jeremy Kilpatrick, 493-519. Reston VA: National Council of Teachers of Mathematics, 2003.
- Gates, James D. "Perspective on the Recent History of the National Council of Teachers of Mathematics." In *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick, 737-752. Reston VA: National Council of Teachers of Mathematics, 2003.
- Glenn, William Holt. "A Curriculum Development to Capitalize on the Interrelationships of the Many Areas of Mathematics." In *The National Council of Teachers of Mathematics. Emerging Practices in Mathematics Education: The Twenty-Second Yearbook*, 9-14. New York: AMS Reprint Company, 1966 (reprint).

- Harding, Lowry W. "Emerging Practices in Evaluation of Elementary School Mathematics." In The National Council of Teachers of Mathematics. *Emerging Practices in Mathematics Education: The Twenty-Second Yearbook*, 355-363. New York: AMS Reprint Company, 1966 (reprint).
- Henkelman, James. "Implementing a New Mathematics Curriculum." *The Mathematics Teacher* 56: 4 (April 1963), 211-217.
- Hilts, Donna. "Equation for a Teaching Crisis." *Washington Post, The (DC)*, August 8, 1982.
- Hlebowitsh, Peter S. and William G. Wraga. "The Reemergence of the National Science Foundation in American Education: Perspectives and Problems." *Science Education* 73:4 (1989): 405-418.
- Hollinger, David. "Science as a Weapon in Kulturkämpfe in the United States During and After World War II." *Isis* 86:3 (Sep. 1995): 440-454.
- Hunter, Lottchen Lipp. "Working Together in Developing the Mathematics Curriculums." In The National Council of Teachers of Mathematics. *Emerging Practices in Mathematics Education: The Twenty-Second Yearbook*, 72-80. New York: AMS Reprint Company, 1966 (reprint).
- Jacobs, Jennifer K. et. al. "Does Eighth-Grade Mathematics Teaching in the United States Align with the NCTM Standards? Results from the TIMSS 1995 and 1999 Video Studies." *Journal for Research in Mathematics Education* 37:1 (Jan. 2006): 5-32.
- Jones, Philip S. and Arthur F. Coxford, Jr. "Reform, 'Revolution,' Reaction: 1945-Present." In The National Council of Teachers of Mathematics. *A History of Mathematics Education in the United States and Canada: The Thirty-Second Yearbook*, 67-92. Washington, DC: National Council of Teachers of Mathematics, 1970.
- Kee, James Edwin and John Shannon. "The Crisis and Anticrisis Dynamic: Rebalancing the American Federal System." *Public Administration Review* 52:4 (Jul-Aug, 1992): 321-329.
- Keitel, Christine. "Perceptions of Mathematics and Mathematics Education in the Course of History - A Review of Western Perspectives." In *Mathematics Education in Different Cultural Traditions-A Comparative Study of East Asia and the West*, vol. 9, edited by Frederick K. S. Leung, Klaus-D. Graf, and Francis J. Lopez-Real, 81- 94. Boston: Kluwer Academic Publishers, 2006.
- Kilpatrick, Jeremy. "A History of Research in Mathematics Education." In *Handbook of Research on Mathematics Teaching and Learning*, vol. 1, edited by Douglas Grouws, 3-38. New York: Maxwell Macmillan International, 1992.

- Klein, David. "A Brief History of American K-12 Mathematics Education in the 20th Century." In *Mathematical Cognition*, edited by James M. Royer, 175-259. Greenwich, CT: Information Age Publishing, 2003.
- Knight, F. B. "Some Aspects of Elementary Arithmetic." In The National Council of Teachers of Mathematics. *The Second Yearbook: Curriculum Problems in Teaching Mathematics*, 3-72. New York: AMS Reprint Company, 1966 (reprint).
- Kraus, Larry. "The Fight Over MACOS," *The New Social Studies: People, Projects, and Perspectives*, edited by Barbara Slater Stern, 309-340. Information Age Publishing, 2010.
- Lagemann, Ellen Condliffe. "Contested Terrain: A History of Education Research in the United States." *Educational Researcher* 26:9 (Dec., 1997): 5-17.
- Land, Deborah and Sam Stringfield. "Educational Governance Reforms: The Uncertain Role of Local School Boards in the United States." In *International Handbook of Educational Policy: Part One*, edited by Nina Bascia, 261-280. Dordrecht, Springer, 2005.
- Lappan, Glenda and Jeffrey J. Wanko. "The Changing Roles and Priorities of the Federal Government in Mathematics Education in the United States." In *A History of School Mathematics*, vol. 2, edited by George Stanic and Jeremy Kilpatrick, 897-930. Reston VA: National Council of Teachers of Mathematics, 2003.
- Lasky, Sue, Amanda Datnow, and Sam Stringfield. "Linkages Between Federal, State and Local Levels in Education Reform." In *International Handbook of Educational Policy: Part One*, edited by Nina Bascia, 239-260. Dordrecht, Springer, 2005.
- Loeb, Vernon. "American Beaten to the Scientific Punch Again." *Philadelphia Inquirer, The (PA)*, October 10, 1982, F edition.
- Long, Vena M. "The Role of State Government in the Custody Battle over Mathematics Education." In *A History of School Mathematics*, vol. 2, edited by George Stanic and Jeremy Kilpatrick, 931-954. Reston VA: National Council of Teachers of Mathematics, 2003.
- Madaus, George, Marguerite Clarke, and Michael O'Leary. "A Century of Standardized Mathematics Testing." In *A History of School Mathematics*, vol. 2, edited by George Stanic and Jeremy Kilpatrick. Reston VA: National Council of Teachers of Mathematics, 2003.
- McGuinn, Patrick. "Swing Issues and Policy Regimes: Federal Education Policy and the Politics of Policy Change." *Journal of Policy History* 18:2 (2006), 205-240.

- McLeod, Douglas B. "From Consensus to Controversy: The story of the NCTM Standards." In *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick, 753-818. Reston VA: National Council of Teachers of Mathematics, 2003.
- Moore, Elikian Hastings. "On the Foundations of Mathematics." In The National Council of Teachers of Mathematics. *The First Yearbook: A General Survey of Progress in the Last Twenty-Five Years*, 32-57. NCTM, 1926.
- Osborne, Alan R. and F. Joe Crosswhite. "Reform, Revolution, and Reaction." In The National Council of Teachers of Mathematics. *A History of Mathematics Education in the United States and Canada: The Thirty-Second Yearbook*, 235-300. Washington, DC: National Council of Teachers of Mathematics, 1970.
- Payne, Joseph N. "The New Math and its Aftermath, Grades K-8." In *A History of School Mathematics*, vol. 1, edited by George Stanic and Jeremy Kilpatrick, 559-598. Reston VA: National Council of Teachers of Mathematics, 2003.
- Picker, Lester A. "Science, Math Illiterates - U.S. is near bottom of the heap in schooling its youth." *The Sun*, (Baltimore, MD), April 29, 1991, Final edition.
- Reeve, W. D. "Improvement of Tests in Mathematics." In The National Council of Teachers of Mathematics, *The First Yearbook: A General Survey of Progress in the Last Twenty-Five Years*, 106-140. NCTM, 1926.
- Reeve, William David. "United States." In The National Council of Teachers of Mathematics. *The Fourth Yearbook: Significant Changes and Trends in the Teaching of Mathematics Throughout the World Since 1910*, 131-186. New York: AMS Reprint Company, 1966 (reprint).
- Research Advisory Committee of the NCTM. "Mathematics Education Research: 1985 in Review." *Journal for Research in Mathematics Education* 17:4 (July 1986), 317-320.
- Research Advisory Committee of the National Council of Teachers of Mathematics, "NCTM Curriculum and Evaluation Standards for School Mathematics: Responses from the Research Community," *Journal for Research in Mathematics Education*, 19:4 (Jul., 1988): 338-344.
- Romberg, Thomas A. "Curriculum, Research, and Development." In National Council of Teachers of Mathematics, *The Teaching of Secondary School Mathematics: Thirty-third Yearbook*, 56-88. Washington, DC: National Council of Teachers of Mathematics, 1970.
- Roskopf, Myron F. "Mathematics Education: Historical Perspectives." In National Council of Teachers of Mathematics, *The Teaching of Secondary School Mathematics: Thirty-third Yearbook*, 3-32. Washington, DC: National Council of Teachers of Mathematics, 1970.

- Rothenberg, Marc. "Making Judgments About Grant Proposals: A Brief History of the Merit Review Criteria at the National Science Foundation." *Technology and Innovation* 12 (2010): 189-195.
- Schoenfeld, Alan. "Cognitive Science and Mathematics Education: An Overview." In *Cognitive Science and Mathematics Education*, edited by Alan H. Schoenfeld, 1-32. Hillsdale, NJ: Lawrence Erlbaum, 1987.
- Schorling, Raleigh. "Suggestions for the Solution of an Important Problem that Has Arisen in the Last Quarter of a Century." In The National Council of Teachers of Mathematics, *The First Yearbook: A General Survey of Progress in the Last Twenty-Five Years*, 58-105. NCTM, 1926.
- Schulman, Bruce J. "Comment: The Empire Strikes Back – Conservative Responses to Progressive Social Movements in the 1970s." *Journal of Contemporary History* 43:4 (Oct. 2008): 695-700.
- Schulman, Lee S. "Psychology and Mathematics Education." In *The Sixty-ninth Yearbook of the National Society for the Study of Education*, edited by Edward Begle. Chicago: University Press, 1970.
- Siegel, Martha J. "Curriculum Development." In *Mathematics Education in Secondary Schools and Two-year Colleges: a source book*, edited by Paul Campbell and Louise Grinstein. New York: Garland, 1988.
- Skovsmose, Ole and Paola Valero. "Breaking Political Neutrality: The Critical Engagement of Mathematics Education with Democracy." In *Sociocultural Research on Mathematics Education: an international perspective*, edited by Bill Atweh, 37-55. Mahwah, N.J.: Lawrence Erlbaum Associates, 2001.
- Slaughter, John B. "The National Science Foundation Looks to the Future" *Science* 211: 4487 (March 13, 1981), 1131-1136.
- Smith, David Eugene. "A General Survey of the Progress of Mathematics in our High Schools in the Last Twenty-Five Years." In The National Council of Teachers of Mathematics. *The First Yearbook: A General Survey of Progress in the Last Twenty-Five Years*, 1-31. NCTM, 1926.
- Tannock, Stuart. "To Keep America Number 1: Confronting the Deep Nationalism of US Higher Education." *Globalisation, Societies and Education* 5:2 (July 2007): 257-272.
- Thorsten, Marie. "Once Upon a TIMSS: American and Japanese Narrations of the Third International Mathematics and Science Study." *Education and Society* 18:3 (2000): 45-76.

- Tuck, Stephen. "Reconsidering the 1970s – The 1960s to a Disco Beat?" *Journal of Contemporary History* 43:4 (Oct. 2008): 617-620.
- Upton, Clifford Brewster. "Standardized Tests in Mathematics for Secondary Schools." In National Committee on Mathematical Requirements. *The Reorganization of Mathematics in Secondary Education*, 279-428. Washington, DC: The Mathematical Association of America, 1923.
- Wang, Jessica. "Liberals, the Progressive Left, and the Political Economy of Postwar American Science: The National Science Foundation Debate Revisited." *Historical Studies in the Physical and Biological Sciences* 26:1 (1995): 139-166.
- Whitfield, Stephen J. *The Culture of the Cold War* 2nd ed. Baltimore: Johns Hopkins Press, 1996.
- Welch, Wayne W. "Twenty Years of Science Curriculum Development." *Review of Research in Education* 7 (1979): 282-306.
- White-Fredette, Kimberly. "Why Not Philosophy? Problematizing the Philosophy of Mathematics in a Time of Curriculum Reform." *The Mathematics Educator* 19:2 (2009/2010), 21-31.
- Woodward, John. "Mathematics Education in the United States: Past to Present." *Journal of Learning Disabilities* 37:1 (Jan/Feb 2004): 16-31.

BOOKS

- Berube, Maurice R. *American Presidents and Education*. New York: Greenwood, 1991.
- Bishop, A. J., M. A. Clements, and Christine Keitel, eds. *International Handbook of Mathematics Education*. Springer, 1997.
- Bishop, A. J., et. al, eds. *Second International Handbook of Mathematics Education*. Springer, 2001.
- Boaler, Jo. *What's Math Got to Do With It?: helping children learn to love their most hated subject--and why it's important for America*. New York: Viking, 2008.
- Burrill, Gail and National Council of Teachers of Mathematics, Center for Science, Mathematics, and Engineering Education. *Improving Student Learning in Mathematics and Science: the role of national standards in state policy*. Washington DC: National Academy Press, 1997.
- Davies, Gareth. *See Government Grow: education politics from Johnson to Reagan*. Lawrence, KS: University Press of Kansas, 2007.

- Dow, Peter. *Schoolhouse Politics: Lessons from the Sputnik Era*. Cambridge: Harvard University, 1999.
- Educational Policies Commission. *Educational responsibilities of the Federal Government*. Washington, D.C.: National Education Association, 1964.
- Gilman, Nils. *Mandarins of the Future: Modernization Theory in Cold War America*. Baltimore: Johns Hopkins Press, 2003.
- Glenn, Brian J. and Steven M. Teles. *Conservatism and American Political Development*, Oxford: University Press, 2009.
- Howson, Geoffrey, Christine Keitel, and Jeremy Kilpatrick. *Curriculum Development in Mathematics*. Cambridge: Cambridge University Press, 1981.
- Lindman, Erick L. *The Federal Government and Public schools*. Washington, D.C.: American Association of School Administrators, 1965.
- McKnight, Curtis C., F. Joe Crosswhite, and John E. Dossey. *The Underachieving Curriculum: Assessing U.S. School Mathematics from an International Perspective: A National Report on the Second International Mathematics Study*. Champaign, IL: Stipes Publishing Co., January 1987.
- Merelman, Richard M. *Making Something of Ourselves: On Culture and Politics in the United States*. Berkeley, CA: University Press, 1984.
- Moon, Bob. *The "New Maths" Curriculum Controversy: an international story*. London: Falmer Press, 1986.
- The National Council of Teachers of Mathematics. *A History of Mathematics Education in the United States and Canada: The Thirty-Second Yearbook*. Washington, DC: National Council of Teachers of Mathematics, 1970.
- National Council of Teachers of Mathematics, *The Teaching of Secondary School Mathematics: Thirty-third Yearbook*. Washington, DC: National Council of Teachers of Mathematics, 1970.
- The National Council of Teachers of Mathematics. *The First Yearbook: A General Survey of Progress in the Last Twenty-Five Years*. NCTM, 1926.
- The National Council of Teachers of Mathematics. *The Second Yearbook: Curriculum Problems in Teaching Mathematics*. New York: AMS Reprint Company, 1966 (reprint).
- The National Council of Teachers of Mathematics. *The Fourth Yearbook: Significant Changes and Trends in the Teaching of Mathematics Throughout the World Since 1910*. New York: AMS Reprint Company, 1966 (reprint).

- The National Council of Teachers of Mathematics. *The Eighth Yearbook: The Teaching of Mathematics in the Secondary School*. New York: AMS Reprint Company, 1966 (reprint).
- Nelkin, Dorothy. *Science Textbook Controversies and the Politics of Equal Time*. Cambridge, MA: MIT Press, 1977.
- Orlosky, Donald E. and B. Othanel Smith, eds. *Curriculum Development: Issues and Insights*. Chicago: Rand McNally, 1978.
- Schulman, Bruce J. and Julian E. Zeilitzer, eds. *Rightward Bound: Making America Conservative in the 1970s*. Cambridge, MA: Harvard University Press, 2008.
- Shelley, Bryan. *Money, Mandates, and Local Control in American Public Education*, Ann Arbor: University of Michigan, 2011.
- Spring, Joel. *The Politics of American Education*. New York: Routledge, 2011.
- Spring, Joel H. *The Sorting Machine Revisited: national educational policy since 1945*. New York: Longman, 1989.
- Vinovskis, Maris. *From A Nation at Risk to No Child Left Behind: national education goals and the creation of federal education policy*. New York: Teachers College Press, 2009.
- Walmsley, Angela Lynn Evans. *A History of Mathematics Education During the Twentieth Century*. Lanham, MD: University Press of America, 2007.
- Whitfield, Stephen J. *The Culture of the Cold War* 2nd ed. Baltimore: Johns Hopkins Press, 1996.
- Wiley, Karen. *The NSF Science Education Controversy: Issues, Events, Decisions*. Washington, D.C.: National Institute of Education, 1976.
- Wooton, William. *SMSG the making of a curriculum*. New Haven: Yale University Press, 1965.
- Zucker, Andrew A., et. al. *A Report on the Evaluation of the National Science Foundation's Statewide Systemic Initiatives (SSI) Program*. Menlo Park, NJ: SRI International, June 1998.