A Decade of COMPASS:

Improving High School Mathematics Education Through a National Curriculum Implementation Center

Kasi Allen
Mark St. John
Pamela Tambe

February 2009
INVERNESS RESEARCH

This material is based on work supported by the National Science Foundation under grant number 013772. Any opinions, findings and conclusions, or recommendations expressed are those of the authors and do not necessarily reflect positions of the National Science Foundation.

Table of Contents

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Executive Summary

What can be done about high school mathematics? This question has perplexed the educational community for nearly a century. However, in the last 30 years, the issue has received increased attention due to the steady rate of student failure in high school math combined with the dearth of math and science majors at the college level and a growing need for a tech-savvy workforce. Teachers bemoan the poor preparation and lack of motivation among their students. Students, in turn, complain about irrelevant courses, confusing content, and boredom. All sense that there must be a better way.

Back in 1992, the National Science Foundation (NSF) awarded grants to five curriculum development teams and charged them with the task of starting over. The goal was to indeed find a better way of structuring and teaching high school mathematics so that all students might experience challenge as well as success in their coursework and thus go on to become productive citizens in the new millennium. The NSF had never made such an investment in secondary mathematics education. A large part of the motivation came from the National Council of Teachers of Mathematics (NCTM) and their publication in 1989 of *Curriculum and Evaluation for School Mathematics*. At the time, no marketed instructional materials existed to support such a forward thinking vision for mathematics education.

By 1997, the five NSF-funded development teams had produced five new innovative and "integrated" curricula (see Appendix A); all represented notable departures from the commonly encountered, calculus-driven high school sequence of Algebra, Geometry, Advanced Algebra, Pre-Calculus, and Calculus. Instead of perpetuating the high school tradition of courses focused on a single discipline, the new instructional materials promoted secondary mathematics courses that purposefully wove together a developmentally appropriate fabric of topics from algebra, geometry, statistics, trigonometry, and so on – not to mention the inclusion of more modern topics, such as networking theory.

With the NSF-funded curricula ready to join the ranks of the textbook market, a new question surfaced – how would real schools and districts go about successfully implementing such programs? As the materials went to publication, the NSF wisely recognized that such innovation would result in new challenges that had not surfaced with the materials generally offered by textbook publishers. Schools and districts willing to take on this critical work would need special support, particularly to initiate and maintain their efforts. For this reason, the NSF elected to fund four national curriculum implementation centers.[1] Only one of these centers focused specifically on the high school—COMPASS.

The COMPASS Center quickly established itself as the primary resource serving schools and districts seeking support for and research related to the dissemination of the NSF-funded high school mathematics programs. The leaders also dedicated themselves to creating greater awareness about these programs from coast to coast. The center has now served the nation in this capacity for more than a decade.

The current report documents the history of the COMPASS Center's efforts and evolving strategies over the past ten years. Inverness Research has served as the external evaluator for COMPASS since 1998. During this period, we have had the opportunity to study multiple NSF initiatives designed to support K-12 mathematics improvement.[2] We draw on these experiences here as we describe highlights of the COMPASS Center's work and detail its specific contributions to broader efforts to improve high school mathematics education. Our intent is not only to chronicle the COMPASS story specifically, but also to illuminate the need for and benefits of the NSF investments made in curriculum implementation Centers in general.[3]

Understanding the work of COMPASS necessitates knowing something about the vision of mathematics education that the Center supports. In 2000, the NCTM published a second standards document entitled *Principles and Standards for School Mathematics (PSSM)*. Similar to the organization's 1989 publication, *PSSM* articulates ambitious goals for K-12 mathematics in the new millennium. The document offers six principles central to any focused and sustained effort to improve mathematics education.

[1] The four curriculum implementation centers funded by NSF are as follows: at the elementary level, the ARC Center (Alternatives for Rebuilding Curricula); at the middle level, the Show-Me Center (National Center for Standards-based Middle Grades Mathematics Curricula); at the high school level, the COMPASS Center (Curricular Options in Mathematics Programs for All Secondary Students); and serving all three grade level bands, the K-12 Mathematics Curriculum Center.

[2] For more information on Inverness Research, Inc. see www.inverness-research.org.

[3] St. John, M., Heenan, B., Houghton, N., and Tambe, P. (2001). *The NSF Implementation and Dissemination Centers: An Analytic Framework.* Inverness Research, Inc.: Inverness, CA. Retrieved from http://www.inverness-research.org/abstracts/ab2001-12_Rpt_CIC_Framework.html.

EQUITY: Excellence in mathematics education requires equity—high expectations and strong support for all students.

CURRICULUM: A curriculum is more than a collection of activities; it must be coherent, focused on important mathematics and well-articulated across the grades.

TEACHING: Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.

LEARNING: Students must learn mathematics with understanding, actively building new knowledge with experience and previous knowledge.

ASSESSMENT: Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.

TECHNOLOGY: Technology is essential to teaching and learning mathematics; it influences the mathematics that is taught and enhances student learning.

While these principles promote a compelling vision, it is not one that can be immediately or easily enacted. In fact, bring such a vision to fruition on a significant scale in real classrooms throughout the United States would require many layers of support in multiple forms. One key support is found in well-designed, "educative"[4] curriculum materials that can challenge both teachers and students to engage in new modes of teaching and learning. Such materials must be significantly different from standard textbooks if they are to shape classroom practice. However, the reality of American K-12 education is this: the more innovative the curriculum products, the less likely their adoption. And even if they are adopted, due to the challenge they pose for both students and teachers, successful implementation demands support that most schools and districts are not accustomed to providing. Without this support, chances are the comprehensive programs will not be implemented as designed and will not achieve their potential. In some cases, their unsupported use could even be counterproductive.

Still, we know that, particularly in the case of high school mathematics, instructional materials determine much of what is actually taught and learned.[5] Significant improvements in high school mathematics thus demand not only well-designed materials but also mechanisms that can help districts and schools adopt and implement the materials successfully. COMPASS and the other curriculum implementation centers[6] funded by NSF

[4] Davis, E. A., Krajcik, J. S. (2005). "Designing Educative Curriculum Materials to Promote Teacher Learning," *Educational Researcher 34/3,* pp. 3-14.
[5] Reyes, B.J., Reys, R.E., Chavez, O. (2004). "Why Mathematics Textbooks Matter," *Educational Leadership 61/5*, pp. 61-66.
[6] For more on the role and efficacy of the Curriculum Implementation Centers, see Inverness Research's two reports *The K-12 Mathematics Curriculum Center at EDC: Cornerstone Claims Report*. See report located at http://inverness-research.org/reports/ab2003-03_Rpt_EDC_CornerstoneClaims.htm and *The NSF Implementation and Dissemination Centers: An Analytic Framework*. See report located at http://inverness-research.org/reports/ab2002-07_Rpt_CIC_Framework.htm

have proven their ability to provide such resources. In fact, it makes little sense to fund the development of highly innovative curriculum without investing in ways to support in their successful use.

Without the national leadership and support that the COMPASS Center has provided over the past decade, the return on NSF's investment in innovative high school curricula would have been significantly smaller. COMPASS has helped to increase the awareness of the national standards; it has provided even-handed and expert advice to schools and districts about the five NSF-funded curricula; and it has engineered multiple strategies to help districts and schools succeed in their implementation of the curricula. In addition, COMPASS has studied and documented both the promises and challenges of the curriculum adoption and implementation process.

In its current form, the COMPASS Center is pursuing an evolved strategy that combines the strength of: 1) research-based, educative curriculum materials (in the form of the NSF-funded high school programs) and 2) a national network of schools and educators dedicated to supporting those who take on the challenge of implementing the designated curriculum programs. We believe that the lessons learned from the COMPASS experience provide strong evidence for the extent to which this strategy can serve as a powerful approach for improving the quality of mathematics teaching and learning.[7] Furthermore, we maintain that the network model as an improvement strategy warrants further study and that COMPASS is particularly well-positioned to pursue the further refinement and development of this strategy for the future.

Overall, the knowledge gained and the expertise developed over the past decade has made COMPASS a significant national leader in the effort to improve high school mathematics. The Center and its network members have demonstrated that the NCTM vision of mathematics education is indeed attainable. Even more than this, COMPASS has established the knowledge base for how that vision might be realized in real schools and districts across the country.

[7] We have encountered similar models elsewhere in our work and have come to call them "curricular-centered networks." For example, the *Interactive Mathematics Program (IMP)* uses a network of regional implementation centers. See http://www.mathimp.org/publications/regional/contact.html.

Introduction

A Decade of COMPASS is an archival monograph, chronicling the work of the COMPASS implementation and dissemination center, its curriculum satellite sites, and network members during the ten-year period from 1997-2007. COMPASS (Curricular Options in Mathematics Programs for All Secondary Students) is a curriculum implementation project funded in part by the National Science Foundation. In writing this monograph, we intend to provide an historical account of the project, and to share with the reader the thinking and strategies that have contributed to the success of COMPASS, to clarify some of the barriers that the project has faced at various stages of its work, and to illuminate for the field the role that COMPASS has played in the field of secondary mathematics education in recent years. We create this monograph not only to preserve the history of COMPASS, but also to illuminate the broader role that the NSF-funded Curriculum and Implementation Centers have played in the advancement of mathematics education in the United States.

At the heart of the COMPASS effort is a desire to improve the teaching and learning of secondary mathematics in the United States. Generations of Americans have bemoaned the dearth of mathematical thinkers in our society. Numerous studies have pointed out the need for a mathematically literate society (National Commission on Excellence in Education, 1983;

Grubb & Oakes, 2007; National Mathematics Advisory Panel, 2008). One of the underlying tenets of the COMPASS project, and the curriculum materials that it promotes, is a deeply held belief that all students can learn rigorous mathematics if given the appropriate opportunity (NCTM, 1989; NCTM, 2000). The COMPASS project, and the entire NSF initiative that spawned the curriculum implementation Centers, is based upon the idea of using research-based "educative curricula"[8] as the leading edge of reform (Davis & Krajcik, 2005). The five curriculum projects supported by COMPASS all aim to provide mathematics materials that:

- contextualize the mathematics so that students can experience its relevance (Lave, 1992; NCTM, 1989);
- integrate topics from multiple subjects (i.e., algebra and geometry) rather than compartmentalize them (Paul & Richbart, 1985; NCTM, 1989);
- incorporate knowledge of how people learn into the development of concepts and the design of lessons (Grouws, ed., 1992; NCTM, 1989);

[8] Curriculum materials for Grades K-12 that are intended to promote teacher learning in addition to student learning have come to be called "educative" curriculum materials.

- make use of applicable technology (Simmt, 1997; NCTM 1989).

The COMPASS Center has interacted with numerous teachers, schools, and districts in implementing these five curricula across the country. Over the past ten years, the COMPASS work has evolved according to changes in the educational context, and the effort continues despite funding challenges. What COMPASS has accomplished is not only worth remembering in the years to come, but the curriculum-led approach it instantiates also warrants further study and investment.

What is COMPASS?

Over the past 15 years, the National Science Foundation has arguably made a greater investment in improving K-12 mathematics and science education in the United States than any other organization. Beginning decades ago, the NSF initiated funding for numerous initiatives aimed at moving K-12 math and science education away from an exclusive focus on teacher-led lectures and toward a more student-centered approach, involving inquiry and exploration. The curriculum products that resulted have undergone a rigorous and extensive development process. All COMPASS-supported curriculum development projects designed, piloted and extensively field tested all their materials in a range of settings working with diverse populations, ultimately publishing all five curricula commercially for broader implementation.[9]

Recognizing that these programs would challenge the system in multiple ways, NSF also funded a group of curriculum implementation and dissemination centers. In mathematics, a total of four centers were funded: one targeting all grades K-12, one concentrating on the elementary level (grades K-5), one focusing on the middle level (grades 6-8), and the COMPASS center, which was designed to serve and study the issues particular to the implementation of the NSF-funded mathematics curricula at the high school level. In total NSF funded five mathematics programs at the high school level.[10] The work of COMPASS began in 1997 as these curricula went to publication.

The Role of Inverness Research

Inverness Research, Inc. is an independent educational research, consulting, and evaluation group that has served as the external evaluator to the COMPASS center since the 1998-1999 academic year. In this capacity, our work has focused largely on studying the overall

[9] For a list of the four centers, see *Appendix A: Satellite Sites and Their Dissemination Strategies*.

[10] The five high school mathematics curriculum series are: *Interactive Mathematics Program (IMP)*; *MATH Connections: A Secondary Mathematics Core Curriculum*; *Contemporary Mathematics in Context (Core-Plus)*; *Mathematics: Modeling Our World (ARISE)*; *SIMMS Integrated Mathematics: A Modeling Approach Using Technology*.

impact of the COMPASS effort, advising COMPASS leaders as the work of the center evolved over time. Our evaluation also included multi-year studies of a small set of implementation sites, researching what it takes to successfully implement the programs that COMPASS supports.

When the Inverness Research team joined the COMPASS effort, the five NSF-funded high school math curriculum projects had only recently completed the curriculum development phase and were in the early stages of implementation and dissemination. It quickly became clear that there was a need, on the part of the nation as well as the center, to better understand the processes and criteria that schools and districts were using to choose, and then implement, their secondary math curricula. Thus, as the first step in our role as external evaluators, we conducted a national survey (sent to district math specialists and math department chairs across the country) which asked about the curricular decision-making processes used in high school mathematics. These surveys were followed up by interviews with key decision makers. The study became known as "the national landscape study of high school mathematics curricular decision making."[11] This work set a strong precedent for the relationship that would evolve between the team from Inverness Research and the COMPASS leaders – namely that of research partners. Expanding on the traditional evaluator/client relationship, we collaborated in the design of the external evaluation so that it involved studying issues pertinent to the COMPASS center as well as documenting the work of COMPASS center itself.

This Report

We have written the current report ***not*** as a comprehensive evaluation report, but more as a culminating monograph – namely, a detailed summary of the history of the COMPASS Center and its key accomplishments, according to those who have worked most closely with COMPASS in recent years and those who have been the direct recipients of its efforts. In writing this monograph, we at Inverness Research also view our work as a documentation of the investment that NSF has made in the COMPASS Center over the past decade. It provides a venue for us to both assess and articulate the myriad ways in which COMPASS has contributed to districts, schools, teachers, and, ultimately, students across the nation over its ten years of operation. It is also an opportunity to draw broader lessons learned about the overall approach and specific design features that lie behind the COMPASS work.

We believe that there is a sound, explicit and grounded case to be made for the investment in this and other NSF-funded curriculum implementation centers. Reports such as this one

[11] St. John, M., Allen Fuller, K., Houghton, N., Huntwork, D., Tambe, P. (2000). *High School Mathematics Curricular Decision-Making: A National Study of How Schools and Districts Select and Implement New Curricula*. See report located at http://www.inverness-research.org/abstracts/ab2000-01_Rpt_Compass_HSMathCurrDecisionMaking.html.

make more transparent the theory of action behind the investment in Centers like COMPASS and bolster the argument that they can make a significant contribution to the country's capacity to improve math education.

History of COMPASS

To understand the workings of COMPASS and the motivation for its funding requires some knowledge of the recent history of math reform, including the set of circumstances and conflicting paradigms that lead to the creation of the Center at the end of the 1990's.[12] A quarter century ago, the publication of *A Nation at Risk* was a federal call to action that impacted educators across the country, but particularly in fields like math and science – subjects in which only a minority of students succeeded at the advanced level, both within and beyond high school.

> *All, regardless of race or class or economic status, are entitled to a fair chance and to the tools for developing their individual powers of mind and spirit to the utmost. This promise means that all children by virtue of their own efforts, competently guided, can hope to attain the mature and informed judgment needed to secure gainful employment, and to manage their own lives, thereby serving not only their own interests but also the progress of society itself.*
> –A Nation at Risk (1983)[13]

One of the key concerns expressed at the time was the perceived gap between what students were learning in school and the skills they needed to be productive citizens and workers in an increasingly technological society. Those calling for reform wanted to help American young people develop and utilize a true "mathematical perspective" by providing more opportunities to think like "real" mathematicians and scientists, to solve engaging problems, and to pursue answers to open-ended questions.

The Math Reform Context

During this period, the discourse about what constitutes effective mathematics teaching and learning began to shift. Among mathematicians as well as math educators, there

[12] Work with the COMPASS curricula would ultimately involve nothing less than paradigm shifts for students, teachers, administrators, parents, higher education faculty members, policy makers, and so on. All of these groups have been considered COMPASS clientele and the Center has made a concerted effort to interact with each constituency—through large national conferences, as well as local and regional meetings. (Examples include but are not limited to: the NCTM annual conferences, sessions at the California Mathematics Council annual meeting, PTA meetings and parent meeting in individual districts, gatherings of state education leaders, meetings of higher education faculty at conferences, as well as individual universities.)

[13] US Department of Education. (1983). *A Nation at Risk: The Imperative For Educational Reform*. Located at http://www.ed.gov/pubs/NatAtRisk/index.html.

appeared to be some consensus that K-12 mathematics education had become a fixed set of procedures to master as opposed to a dynamic discipline, powerfully shaping the modern world. Throughout the 1980s, a team from the National Council of Teachers of Mathematics (NCTM) worked to create a vision of teaching and learning mathematics that might help shift the thinking of educators and the public alike as to what mathematics education should and could be. Their *Curriculum and Evaluation Standards for School Mathematics*, published in 1989, offered a bold vision for what K-12 mathematics education might be – a vision that departed markedly from what most American adults had experienced as students.

NCTM's *Curriculum and Evaluation for School Mathematics* offered a general framework for what the K-12 mathematics curriculum should include in terms of content priority and emphasis, building on five general goals for all students:

1) to learn to value mathematics,
2) to become confident in their ability to do mathematics,
3) to become mathematical problem solvers,
4) to learn to communicate mathematically, and
5) to learn to reason mathematically.

In short, the overarching goal was the mathematical empowerment of *all* students—highly ambitious, given the tendency for most students to discontinue mathematics study as early as possible combined with the common cultural perceptions of math as an elitist and abstract discipline, disconnected from the human experience, and exceedingly difficult to master.

Given the direction and changes proposed, any attempt to implement the NCTM *Standards* was sure to be daunting. However, nowhere was this more the case than at the high school level. To begin, the *Standards* recommended that many topics in the traditional curriculum be de-emphasized—topics like conic sections and polynomial factoring. There was even a suggestion to eliminate topics in order to make room for more modern mathematics and the inclusion of available technology, such as graphing calculators. In addition, the authors discouraged the teaching of calculus at the high school level, encouraging schools and districts to instead offer more alternatives for students in other areas of mathematics, such as statistics and discrete mathematics – subjects deemed to be much more relevant to students and their future careers. Moreover, the *Standards* implied that one of the issues limiting the quality of mathematics teaching and learning at the high school level was widespread use of the ability-grouped courses and the rigid adherence to a calculus-driven series of offerings that began with Algebra, followed by Geometry, then a second year of Algebra, and so on.

The vision laid out by the *Standards* was equally compelling and overwhelming. Even for the most skilled and motivated high school mathematics teacher, it was unclear how one might actually affect the implementation of such radical changes. While many teachers agreed that the traditional series of courses did not provide the best conditions for the majority of students to learn mathematics, envisioning what curriculum and instruction might look like according to the *Standards*, especially given a solid tradition of using the current programs and textbooks, proved difficult. In short, teachers as well as administrators could see the value of the *Standards*, but not how to implement them.

NSF Funds Mathematics Curriculum Development

Concerns began to surface that without access to aligned curriculum and instructional materials, the majority of teachers would be unlikely to implement the NCTM *Standards* or to make any significant change in what they taught and how they taught it. While teachers are generally willing to infuse incremental changes into their practice and curriculum, the kind of mathematics reform put forth in the *Standards* would require something more. The NSF recognized that such a significant shift in the conceptualization of the high school mathematics program would necessitate unprecedented change on the part of teachers and students – and that the availability of innovative curricula would be a necessary, if not sufficient, element of that change.

Understanding the need for new, high-quality curricula that would align with the *Standards*, in 1992 the National Science Foundation (NSF) funded the development of five new high school mathematics programs. Developers were instructed to design new curricula that would provide students with a much richer and deeper high school mathematics experience than that afforded by the traditional sequence. Each of the grants for the five NSF-supported high school mathematics projects ran for a period five years—roughly from 1992-1997. The grants represented opportunities for the developers to carefully reconsider all assumptions about secondary mathematics education, to essentially start over and re-define the high school mathematics experience. Not surprisingly the five programs that resulted each have their own individual character. However, they bear a strong resemblance as a family of curricula, sharing many common attributes, i.e., all are integrated curricula that place an emphasis on higher-order thinking, on mathematical modeling, and on the appropriate use of technology.

Most notably, all of the five curricula are highly ambitious programs that involve much more than incremental change within current offerings. Full implementation of any of the five necessitates replacing the familiar "Algebra through Pre-Calculus" sequence with a coherent program of three or four integrated courses that are cumulative and comprehensive. Across all of the programs, the proposed year-long courses emphasize developing rigorous mathematical thinking versus mastering isolated mathematical techniques, presenting a vision of mathematics and mathematics teaching that most teachers find unfamiliar. Had the developers produced something with which teachers

were already familiar, it is quite likely they would have created materials that were more readily adopted, but they would also have missed their mark in terms of creating materials that instantiated the vision of the Standards. By recasting high school mathematics in such a comprehensive and programmatic fashion, all five of the NSF secondary mathematics curricula are asking teachers not only to teach math in a very different way but to teach a different mathematics. For example, all of the programs include more statistics, discrete mathematical modeling, and contemporary topics than a standard textbook series. Also, all five curricula were designed for and intended to be accessible to all students— posing new challenges for teachers and administrators, as well as the students themselves.

NSF FUNDS COMPASS

As the development phase for the five curricula drew to a close, the NSF was also aware that in order for these programs to be used in real schools and districts, they would need to do more than simply support their development. The foundation would also want to actively support their adoption and implementation. Hence, COMPASS was funded to provide a coordinated and collective dissemination and support effort for the five projects. The publishers alone could not provide a sufficient interface between schools and these five innovative secondary math projects. COMPASS was funded to provide a more extensive and informed interface with the goal of providing the following functions:

- to promote the five NSF-funded high school curricula as a group and to educate people about their existence;

- to provide education and information about the specifics of the five curricula without showing a preference for one over another;

- to help schools and districts that selected one of these programs to connect with the relevant curriculum developer, to garner adequate local resources for implementation, and to provide concrete support as they proceeded with that implementation;

- to engage in ongoing learning about the emerging implementation issues surrounding these innovative programs and to disseminate this knowledge to new and existing users of the curricula.

In taking on the challenge of fulfilling these functions, COMPASS evolved into a national leader for high school mathematics improvement. The COMPASS Center not only worked with local districts but also became a leading advocate for high school math reform at the national level. In an effort to maintain neutrality with respect to the five curricula, COMPASS studied each program in a detailed and systematic way – gaining a unique knowledge of these curricular programs that was of interest to districts nationwide. And, because of their work over many years with many districts, COMPASS would become the

national repository for a wealth of stories and lessons learned about high schools attempting to implement innovative high school mathematics curricula.

There were several rationales for having a national Center that promoted these five innovative curricula. One was to reduce the counter-productive types of competition between projects that might result without a common implementation center. Another was to find and take advantage of the economies of scale that could result from a combined dissemination effort, having one overarching national Center do the work of promoting the general need for mathematics education reform, as well as educating schools and districts about each of the individual curricula. Another rationale for COMPASS was to have a way to stress the commonalities across multiple programs – emphasizing how all five represented different instantiations of the same as opposed to five disparate approaches. Through the efforts of COMPASS, as well as the efforts of the individual curricular projects, NSF hoped that the dissemination of the curricula would be greatly increased, and, equally important, that the combined effort could help bring about a shift in the public's perceptions of high school mathematics – as well as changes in the teaching and learning of this high school subject so powerfully bound by tradition. While the theory of action has played out roughly as planned, the work has been much more challenging, complex and political than anyone might have anticipated ten years ago (Reys, 2001).

COMPASS Purpose and Design

THE STRUCTURE

As initially conceived, COMPASS consisted of six partners – the COMPASS central office and the five curriculum development projects. In terms of the distribution of resources, at least initially, each of the six sites received equal portions of the COMPASS funds.[14] In the early years, they pooled resources to pay for some common activities such as supporting a staff person in the COMPASS central office, maintaining a central website, creating and distributing brochures, and traveling to conferences for regional and national presentations. Beyond this, however, each satellite independently chose to make best use of its funds and to engage in the work of dissemination and implementation according to their particular project needs and the relationship they had with their publisher. (See Appendix A for a brief description of each satellite and the strategy for disseminating their program as part of the larger COMPASS effort.)

[14] Ultimately, COMPASS would receive multiple grants from the NSF to support the Center's ongoing work. Later funding was dedicated primarily to the efforts of the central site.

THE ROLE OF THE CENTRAL COMPASS SITE

Funding for the central COMPASS site created a national office that has connected and promoted the dissemination work of the five curriculum projects as well as the broader vision of secondary mathematics education upon which each one is based. At the end of the 1990s, as the five curriculum projects went to publication, the COMPASS central office served as a first point of contact for schools and districts interested in any one of the programs, although schools and districts could also contact satellites and curriculum developers directly. From the outset and to this day, there are three primary ways that the COMPASS central site has provided a national coordinating function for the National Science Foundation's secondary math implementation effort:

1) Communicating a Shared Vision

COMPASS staff from the central site have presented regularly at national conferences, regional workshops, and in local counties and districts for the last ten years, and they continue to do so. Until fairly recently, they responded to the requests of schools and districts nationwide on an "on-call" basis, discussing the national standards, showcasing the five programs, and supporting the curriculum selection process. Over the years, they have worked with constituents at all levels of the education systems – including policy makers and university faculty. In addition, a team of "COMPASS Associates" – educators with significant professional experience with one or more of the curricula – have helped by presenting the public face of COMPASS at conferences and collaborating with individual districts.

2) Building Community Across the Curriculum Projects and their Implementers

At every stage of their work, the directors of the COMPASS central site have strived to create a community among the five satellite sites, so that as profession colleagues they use common language across programs and so that the satellite directors, as a group, can learn from each other. To the extent that funds and schedules have allowed, the COMPASS directors have tried to create opportunities for representatives from all five of the curriculum projects to come together to share ideas and strategies.

3) Maintaining a Centralized Reference System

COMPASS houses a library with a full set of all the curriculum materials from the five projects as well as much of the research connected to the five programs. For more than a decade, COMPASS has also supported an umbrella website that provides general information about math reform and detailed information about each of the five math curricula, as well as electronic links to each of the individual project websites (see www.ithaca.edu/compass). The central site has also taken the lead in addressing public

relations issues and keeping the community of COMPASS curriculum supporters abreast of political and policy developments that might have an impact on the implementation of one or all of the programs. More recently, the COMPASS website has also posted current research about the NSF-funded high school programs, thus serving as a clearinghouse for new knowledge and learning connected to these programs.

Evolution of COMPASS

From the beginning and by design, COMPASS pursued a simultaneous, two-pronged approach – dissemination and implementation. The initial vision was that, over time, the work would gradually shift away from dissemination and toward implementation. However, even ten years later, people still want to learn about these programs, and dissemination has never stopped being a critical part of the COMPASS effort. The ongoing need for creating awareness, articulating the vision underlying the NCTM Standards and "bringing newcomers to the table" is one of the lessons learned from this initiative. Nonetheless, the work has over the decade evolved away from a clearinghouse role and more toward an emphasis on supporting the schools and districts engaged in the day-to-day implementation of the five programs. It is, by necessity, complex and multi-faceted, illustrating the sophistication that is needed to successfully help districts and schools use educative curriculum as a leading edge of reform. In the sections that follow, we describe eight different aspects of the work that COMPASS has engaged in to support the improvement of high school mathematics teaching.

Creating Awareness

When COMPASS first received its funding, all involved fully understood that there was a tremendous need for getting the word out about the existence and promise of these new programs. COMPASS leaders also anticipated that there would be significant awareness work to do regarding the NCTM *Standards*. However, no one anticipated the breadth or depth of effort that this "awareness" work would require.

> *The COMPASS workshop really opened our teacher's eyes to the fact that the 'fun and games' part of math is really the substance. It was a reorientation in our thinking about how to teach math and how to help all kids be successful.*
> —District Assistant Superintendent

During the 1998-99 school year, Inverness Research conducted a national landscape study of the high school mathematics curriculum decision-making – in part, to better understand the national context in which COMPASS was attempting to do its work. One of the early findings from the external evaluation was that while nearly all of the respondents had heard of at least one of the NSF-funded programs, less than half were aware of the existence of all five.

Disseminating Information

> *We had been working for a few years to improve student performance in relation to our math standards. But we hadn't done any work at the high school. We needed to do some seeding there and COMPASS gave us the seeds. They let our teachers see that there are people out there doing things differently.*
> – Director, State Institute of Science, Math, and Technology

Much of the COMPASS dissemination effort has taken place through the website, curriculum showcases, and conference presentations (e.g., NCTM, NCSM, and MAA). This work was done at both the regional and national levels. However, much of it also focused on working at the grassroots level – and for good reason. The national landscape study pointed out the importance of individual teachers in the curriculum selection process that takes place at the high school level in mathematics. There are multiple reasons for this. First, high school mathematics teachers listen to each other and trust each other's guidance more than they do any other source. Second, the real process of choosing high school mathematics curricula is, often in subtle ways, more teacher-dependent than many realize. Above and beyond their involvement on curriculum committees, the opinions of high school math teachers carry substantial weight throughout the process. Few department chairs and district administrators are willing to go against the wishes of their high school mathematics faculty. And even school board members pay careful attention to math teacher recommendations when approving new curriculum materials.

Aiding in Selection and Adoption at the District and State Level

> *We knew we wanted to choose an NSF-funded curriculum, but there was only one [curriculum] being used in our area and so what could we do to learn about the others? How could we really see the way the other programs are used without COMPASS?*
> —District Curriculum Coordinator

The COMPASS response to schools and districts requesting advice about curriculum selection has evolved over the years. Initially, if there was authentic interest in choosing one of the programs, the COMPASS central site made arrangements for the district to participate in a three-day "implementation" workshop. These sessions helped participants develop a programmatic view of math reform. By this we mean that COMPASS helped the districts envision curriculum adoption as a central part of developing a coherent mathematics program (9-12), not just selecting a textbook. Hence, COMPASS helped districts understand what was involved in developing a strong mathematics program as well as helping them become more knowledgeable about all five of the COMPASS curricula. Much attention was paid to the multiple supports and substantial effort that was required to successfully implement these curricula. However, at no point did the COMPASS endorse one program over another. This impartial stance of the COMPASS leadership enabled participants to fully consider all of their options and to see the commonalities across the programs. On the other hand, the COMPASS Center's

commitment to maintaining this neutral position limited its ability to help schools and districts make the final selection of a program. This is where the satellites would step in, with their own websites and workshops.[15]

It is important to note that COMPASS conference presentations as well as the national landscape study also contributed to this aspect of the Center's work. Throughout its history, COMPASS has presented itself as a knowledgeable but neutral national resource – supporting a set of reform-minded curricula, grounded in the NCTM *Standards*. Our data show that COMPASS has done its dissemination work in a manner that clients and satellites perceive as even-handed and fair. For this reason, we have sometimes described COMPASS Central as a broker of the NSF-funded high school mathematics programs – COMPASS staff clearly know the curricula individually and collectively, but they are promoting a particular type of program, not a specific publisher or author.

Supporting Early Implementation

> *In hindsight, we predicted that these programs would upset the balance of the system. But the level of difficulty that people would encounter in trying to implement them is something we never could have predicted.*
> – Eric Robinson, Professor of Mathematics, Director of COMPASS

The earliest adopters of the five COMPASS programs often received support from multiple sources. In those initial years, districts could readily establish a working relationship with their curriculum developer. Many were involved in larger local or regional reform efforts – such as State Systemic Initiatives or Local Systemic Change projects (also funded by the National Science Foundation). Given the range of supports available, NSF hoped for widespread implementation of its innovative high school mathematics programs. However, the nature of the innovation combined with the demands these curricula place on the system would make this unlikely. The preparation and support needed to even consider such a reform path would be significant – and not many districts or schools were likely to be ready to take on such a challenge, at least initially.

Data from the COMPASS landscape study confirm that there were, indeed, a relatively small number of schools and districts positioned to successfully implement one of the COMPASS curricula. Moreover, the majority of districts across the nation reported that feeling satisfied with their current curriculum, and any changes to be made were more likely to be incremental and not as radical as those that the COMPASS curricula required. Given these facts, it is easy to understand why COMPASS ended up targeting the "niche

[15] That COMPASS has never been affiliated with a publisher affords the center a high degree of trust among schools and districts. To this day, COMPASS receives requests for "impartial" assessments of curriculum products beyond the five it supports—College Preparatory Math, for example—an indication of the ongoing need for impartial information related to curriculum decision-making and implementation.

market" of schools that had either already begun implementing one of the NSF-funded curricula or appeared soon to do so.

It is important to note that most of the early-adopting districts strategically sought out additional supports as they pushed toward making their vision of mathematics education a reality. Due to the novelty of the programs, as well as their promise for improving high school mathematics education for underachieving students, many districts were able to garner some combination of national, state and private foundation funding to assist in their reform efforts. COMPASS both took advantage of these extra funds, and, in some cases, helped districts to acquire additional supports for the curriculum implementation.

Making the Case for the NSF-funded Programs

> *Traditionalists fear that reform-oriented, "standards-based" curricula are superficial and undermine classical mathematical values; reformers claim that such curricula reflect a deeper, richer view of mathematics than the traditional curriculum. An historical perspective reveals that the underlying issues being contested—Is mathematics for the elite or for the masses? Are there tensions between "excellence" and "equity"? Should mathematics be seen as a democratizing force or as a vehicle for maintaining the status quo?—are more than a century old.*
> –Alan Schoenfeld, "The Math Wars"

Even though COMPASS sought to work with those districts and schools that were most interested in and engaged with reform, the COMPASS Center could not avoid the increasingly politicized climate that characterized mathematics education at the end of the 1990's and well into the millennium. When the COMPASS Center first received its funding, the country had not yet experienced "the math wars." However, only months after their publication, many of the COMPASS curricula were targeted by traditionalist mathematicians and public groups. While COMPASS did not initially envision themselves as a political entity, the Center found itself unable to avoid having to take on a prominent role advocating for the NCTM standards and the NSF-funded curricula.

The new NSF-funded programs had to compete within the broader educational and political landscape that shaped how curricula were judged, selected and implemented. These new innovative curricular programs were designed to push the system, and to shift the dominate paradigm of how mathematics was to be taught and learned. Not all agreed that these programs represented a positive direction of change. Not surprisingly, then, the COMPASS-supported programs both individually and collectively, were quite suddenly under harsh criticism from organizations such "Mathematically Correct"[16] that assisted

[16] Mathematically Correct is an informal, nationwide organization that views much of reform mathematics as "fuzzy math" and advocates for a "back to basics" approach. Local organizations have a reputation for serving a vocal minority than can undermine efforts to implement the NSF-funded mathematics curricula. See http://mathematicallycorrect.com.

skeptical parent groups in discrediting and in some cases dismantling COMPASS implementation efforts. The fact that the director of COMPASS is a mathematician somewhat helped to bolster the image of COMPASS as a "neutral" organization. Nonetheless, COMPASS increasingly found itself devoting considerable time and resources to help districts counter the attacks on the NSF-funded programs they were working to implement. Supporting districts in their implementation efforts became a political effort as well as a substantive one.

Studying Deeply the Work of Implementation

> *We thought we knew what we were getting into when we chose our program. But as it turns out, we didn't know the half of it.*
> – High School Principal

While developing their curricula, all five of the COMPASS satellite sites had strong, collaborative relationships with their pilot and field test schools. They thus had a good sense of how districts were doing in terms of supporting and implementing their curricula. However, as publishing companies took increasing control of sales and distribution, satellite sites could no longer keep track of those using the COMPASS curricula. Given the level of innovation of these programs combined with the political climate in which they were being implemented, the satellite directors as well as the leaders of COMPASS Central wanted to know more about how well schools and districts were doing as they engaged in the complex, challenging work of implementation.

In response, COMPASS sponsored Inverness Research to conduct an in-depth case study of each of the five curricula. From 2000-2002, we studied five different districts in five different locations across the country, each using a different COMPASS curriculum. (See Appendix C for a list of the five sites.) As the data collection for the implementation stories proceeded, the lessons learned were shared with the satellites and disseminated as part of COMPASS curriculum showcases and conference presentations. In 2004, Inverness Research produced a monograph entitled *Challenging the Gridlock: A Study of High Schools Using Research-Based Curricula to Improve Mathematics Teaching and Learning*,[17] which presents the details of each of the five implementation stories.

Challenging the Gridlock also includes a cross-site analysis that documents some of the common experiences of the five implementation sites. What is clear from this research is the very tenuous nature of trying to put such an innovative mathematics program in place at the high school level, even under the best conditions. In all of the cases we studied, the

[17] St. John, M., Allen Fuller, K., Houghton, N., Tambe, P., Evans, T. (2005). *Challenging the Gridlock: A Study of High Schools Using Researched-Based Curricula to Improve Mathematics*. See report located at http://www.inverness-research.org/abstracts/ab2005-10_Rpt_Compass_HSCurr-Multi-year-study.html.

implementation effort faced a serious challenge or barrier in the 3rd or 4th year – in some, the work carries on; and in others, this sort of difficulty proves to be the beginning of the end of that program's viability. Still, even when programs were discontinued, we learned that the process of implementation itself had contributed to growth in capacity at both the institutional and personal level. As one teacher explained:

> *You just can't go back. Once you've experienced what math can be like—not just for the students, but for you as a teacher—I think it changes you. It's like a transformation. Even if they give you the old books, you won't teach from them they way you used to.*

The results of this study suggest that the success of the implementation effort associated with an educative curriculum is not only judged by the lifespan of the adoption, but also by the long-term contributions intrinsic to the experience.

Learning about Schools and Districts Committed to the Long-term Work of Innovation

> *There's a lot of things you do in the beginning, like parent education and new teacher training, that you think you won't have to do later on. But you do, because there are always new parents, new students, and new teachers. Truth be told, you have to do it all, ever year. You can never let up.*
> —High School Math Department Chair

During the period in which Inverness Research conducted the study of the COMPASS implementation story, the Center hosted two national curriculum showcases – one in Raleigh, North Carolina and another in Denver, Colorado. Staff from all five satellite as well as multiple implementers of the five COMPASS curricula were involved in putting on these events. Both events were very successful in providing an opportunity for interested schools and districts to come and learn about selecting and implementing one of these programs. But they also emphasized the need for long-term ongoing external support for districts taking on the challenge of reforming their mathematics programs using these educative curricula as the focal point for improvement.

Both the landscape study and the collection of case studies heightened the interest of COMPASS leaders in simultaneously learning more about and further supporting those districts committed to long-term implementation. They now knew that the work of implementation is very challenging and that it requires continual attention and ongoing effort. Typically, the schools undertaking the implementation of one of the COMPASS curricula are engaged in a multi-year developmental process that involves 1) reworking their mathematics course offerings, 2) engaging in significant professional development, and 3) garnering support from multiple constituents including school staff, administration and local community members, not to mention students. Even those that achieve the full "implementation" of these programs need support, both to sustain the program and to increase its quality.

The question then arose as to ***how*** to best support schools engaged in implementing the NSF-funded mathematics programs. The experience of the IMP program, as well as other efforts with which COMPASS were familiar (such as the National Writing Project)[18] suggested that a network strategy might be successful in efficiently providing mutual support. That is, the idea behind a network strategy is that the schools and teachers actually engaged in the work might well be the best resource for others engaged in the work.

COMPASS then formalized the idea of a network of implementation sites. This network of engaged local curriculum leaders would become part of the larger COMPASS community that already included the curriculum developers, practicing teachers, teacher educators, educational researchers, and mathematicians. The theory was that schools in the network would support each other in their related efforts, engage in collaborative work that was mutually beneficial, and ultimately, establish an entity that would be much stronger than any one school or district operating in isolation.

COMPASS leaders held a planning meeting with potential founding network members in January of 2004. The reaction of participants was overwhelmingly positive:

> *This meeting was far more beneficial than I ever thought it would be. The activities were a huge plus because they got us interacting with members of different innovative mathematics communities and they got us thinking about our individual programs and how to make them more stable. I didn't need any input on the benefits of my program but I did need to know that the problems I face in my school are the same as those in innovative mathematics programs all over the country.*
> —High School Mathematics Teacher

Following the meeting, the COMPASS leaders made plans to obtain NSF approval for the network strategy. From this point on, as funding for the satellites ran out, establishing the COMPASS high school network and supporting its work would be the focus of the Center.

Connecting Schools and Districts Dedicated to Staying the Course

> *This has been an eye-opening experience. It's also given me my breath back knowing that our school is not alone, but also traveling down the right path. It was so refreshing hearing people speak honestly about these programs. They're not perfect by any stretch of the imagination, but they are definitely rooted firmly in the best intentions for our students.*
> —Math department chair

[18] For more information about the National Writing Project network, see http://www.nwp.org/.

In founding the high school network, COMPASS leaders at the central site worked closely with the individual satellite directors to identify appropriate candidates. They established general criteria for nominating schools and/or districts which were as follows:

a. A comprehensive (full-program) implementation of at least one of the COMPASS-affiliated curricula such that the full-program implementation has existed for at least two years (although not necessarily in all tracts)

b. An on-going professional development component or active membership in a curriculum users group

c. Documented support at the department, school, and district levels

d. Commitment to maintain the curriculum for (at least) two additional years at the time of Network induction

e. Interest in continued improvement of the program implementation

f. Opportunity to document the curriculum implementation by COMPASS-related researchers

The first official network meeting took place in Washington, D.C. in the fall of 2004. It involved a total of 34 individuals representing ten high schools, four curriculum projects, and the COMPASS center. Much of the focus of that first meeting was on identifying the groups' common or foundational beliefs[19].

> *[The network] has begun to bring my vision into focus about why we made this change in the first place and has reminded me that the vision needs to be shared with my colleagues. I have been challenged to take a more active role in the leadership of my department.*
> —Mathematics Department Chair

A second meeting of the national network occurred in the fall of 2005 in Monterey, California. The meeting included new and returning members. Here, the group shared resources and strategies for a variety of common issues, such as increasing awareness and understanding of the programs among parents and community members. They also decided on a name: COMPASS POINTS (where COMPASS acronym remains the same, "Curricular Options in Mathematics Programs for All Secondary Students," and POINTS stands for "Professionals Operating in a Network for Teachers and Students").

A third face-to-face meeting took place in Golden, Colorado in the fall of 2006. One of the defining characteristics of this meeting was the extent to which the group engaged in collaborative work relevant to all members. For example, at the time, NCTM was considering creating a set of curriculum focal points similar to what the organization had recently published in its *Curriculum Focal Points for Mathematics in Pre-Kindergarten through 8th*

[19] See *Appendix D: COMPASS POINTS Network Foundational Beliefs*.

Grade. Network members had some common concerns about how a similar high school document might affect the work of those seeking to implement the NSF-funded curricula. Therefore, they collaborated to write a letter to the NCTM board of directors. In response, the director of COMPASS was invited to participate in the writing panel that collaborated for more than a year to create NCTM's latest high school curriculum document *Focus on the High School (forthcoming)*.[20] This was, yet again, another good example of the political and policy dimensions of the work of COMPASS and its fledging network.

During the 2007-08 school year, network members collaborated electronically: supporting each other from a distance, updating each other on recent events at their school site, and spurring each other on to continue to work for what they believe is better mathematics education for their students. In its formal study of the network during the spring of 2008, Inverness Research found that COMPASS POINTS contributes to both individuals and to school-based implementation efforts. Individuals report that they have benefited from:

- increased knowledge of the five NSF-funded curricula as a set of related programs,
- a clearer vision of high-quality mathematics teaching and learning,
- a connection to national experts dedicated to improving mathematics education,
- greater confidence in addressing the political aspects of mathematics reform,
- more willingness to serve as a mathematics leader in their school or district.

Likewise, schools engaged in the network benefit from:

- reduced isolation,
- connection to other schools implementing one of the NSF programs,
- a stronger commitment to the implementation effort at their school,
- an enhanced ability to support math implementation efforts,
- a deeper understanding of the issues involved in implementing an NSF-funded program.

[20] See *Appendix E: COMPASS POINTS Letter To NCTM Directors*.

COMPASS leaders now continue to seek further funding for the high school network and to devote the Center's remaining monies to maintain a web-based presence for the overall COMPASS work.[21]

Contributions of the COMPASS Effort

After more than ten years of work, the COMPASS Center contributed much to schools and districts nationwide as well as the field of mathematics education in general. The remainder of this monograph highlights these contributions. It also speaks more broadly to the implications of the COMPASS work for future investments in curriculum centers and curriculum-driven high school mathematics improvement. We emphasize the direct impact of the Center itself, as opposed to the more local benefits that come to students and teachers who implement one of the programs that COMPASS supports.

In what follows we underscore and briefly explain some of the key contributions that the COMPASS Center has made to the districts and schools it has worked with.

- **COMPASS has served as a neutral third party for high schools and districts interested in learning about the NSF-funded curricula**

The neutrality of COMPASS towards its five supported curricula has proven to be a major determinant of its success in helping districts in their curriculum adoption program. There is a strong hunger for objective and neutral advice about curriculum programs, and often publishers can not provide such advice and information. For over ten years COMPASS has supported schools and districts during their adoption processes, helping them to understand the commonality of the group as well as to identify the distinguishing features of each of the five programs.

- **COMPASS has provided customized support for schools and districts that reflects the learning of the Center as well as the local needs of the implementing site.**

The Center has never promoted a "one size fits all" approach, honoring the particular circumstances and local knowledge of each individual implementation effort. In the early years of the Center's work, COMPASS teams often visited districts to work directly with teachers and administrators as well as curriculum adoption committees. In doing this work COMPASS had the goal of finding the appropriate curriculum for that district in their particular stage of development. COMPASS leaders would not shy away from advising

[21] As a supplement to grants from the National Science Foundation, Ithaca College in New York has also provided ongoing financial support for the COMPASS Center, which is housed at the college.

districts to not adopt one of these programs, given their current capacity to support such adoptions. In some cases, then, COMPASS helped districts to decide that these curricula were indeed *not* for them. This is yet another reason to invest in curriculum implementation Centers: to help avoid the disaster that occurs when districts invest in the adoption of an educative curriculum without fully realizing what is involved.

- **COMPASS has served as a repository for lessons learned about implementing the NSF-funded curricula at the high school level, thus supporting new implementers in not making the same mistakes that some of their predecessors may have made.**

COMPASS reaches out to new adopters, and, in turn, new adopters reach out to COMPASS. In this process knowledge and experience are shared, and COMPASS becomes the repository for the ever-growing bank of experience of those schools and teachers struggling with implementation challenges. Through networking, both formal and informal, this knowledge base becomes available to all, and creates a likelihood of success for newcomers to the work.

- **COMPASS has connected schools and districts to others (curriculum developers, pilot sites, and so on) that have experience with the program they are working to implement.**

In the early years, once a site had selected a particular COMPASS curriculum, the Center contacted the appropriate curriculum developer via one of the COMPASS satellite sites and let the two forge their own relationship. In the later years, similar connections have taken place via the COMPASS POINTS network. The fact that the COMPASS Center had the curriculum developers as the key members of the Center is critical in providing schools and teachers with access to those who know the curricula best.

- **COMPASS has encouraged districts, schools, teachers and students to use the curriculum in ways that are faithful to the intended purposes and design of the curriculum.**

These curricula are more than textbooks and thus their implementation needs to be viewed differently. COMPASS encourages schools and districts to commit to strategies such as professional development for all staff (not just the math department), ongoing communication with families, common planning time for teachers teaching the same course, incremental implementation, and investment in the appropriate technology, to name a few. By helping districts understand that they are creating mathematics programs, and not just teaching a new book, the COMPASS Center has helped districts to realize the potential that is latent in the expert design of these curricula.

- **COMPASS has fostered a cross-curricular awareness among schools and districts using the NSF-funded programs, creating a sense that all implementers are part of a much larger national effort that extends far beyond their selected program.**

There is a tendency for teachers and schools to identify with the particular curriculum they have selected and to seek connections to those using the identical program. While such relationships are undeniably valuable, COMPASS helps all implementers understand that each of the five COMPASS curricula have been designed to embody the same set of principles and values. As a result, they all face many of the same common challenges and issues. This realization helps new implementers recognize a much larger circle of colleagues and institutions that are potential professional partners in their local mathematics improvement effort.

- **Through its Network, COMPASS has strengthened the presence of the NSF-funded curricula on the national scene, re-ignited the enthusiasm and commitment of early implementers, and provided a litmus test for the viability of these programs in real schools and districts.**

The COMPASS POINTS network provides a vehicle for strong implementers of the COMPASS curricula to strengthen their voice. They increase their ability to advocate for the approach in general and the curriculum in specific. They gain the potential also to combine their voices and speak as one – as they did in writing to the NCTM about the draft of the focal points document. Collectively, the network affords schools and districts a much stronger platform for advocacy than each could achieve on its own.

COMPASS Contributions to Secondary Mathematics Education

In addition to the benefits to schools and districts, COMPASS has also contributed more broadly to the overall field of secondary mathematics education in the United States.

- **COMPASS has provided a centralized, national voice for the work of innovative curriculum implementation in high school mathematics.**

The tradition of what constitutes American high school mathematics is so strong and deeply engrained that many (administrators, teachers, students, and parents) cannot imagine it any other way – a considerable obstacle for any implementation effort.

COMPASS has established itself as a national advocate and voice for the radically different vision of mathematics education as reflected in the NCTM Standards. As efforts to improve mathematics education became highly public and increasingly politicized, COMPASS has consistently advocated for the NSF-funded curricula not for their own sake, but as a means to achieve the vision of mathematics education as reflected in the

NCTM standards. Two aspects in particular stand out in this advocacy: first, that mathematics education should better reflect the work of practicing mathematicians and, second, that high-quality opportunities to learn mathematics should be accessible to all students.

- **COMPASS has explored and promoted a curriculum-led improvement strategy in high school mathematics education.**

For ten years, COMPASS has explored ways to improve mathematics teaching at the high school level using innovative educative curricula as the driving force and leading edge. At the elementary and middle school levels the adoption and implementation of innovative mathematics curricula has increased in the last decade, with some evidence suggesting that innovative curricula now have a 20% market share or greater. By comparison, at the high school level, where math teachers have high levels of autonomy, there is less use of innovative curricula. COMPASS has promoted the use of the NSF–funded curricula among high school mathematics teachers and leaders and, equally important, promoted the idea that such educative curricula can serve as a center point for broader program improvement.

- **The work of COMPASS provides a "proof of concept" for the NCTM standards.**

The COMPASS strategy serves as a model of how to help schools and districts begin to realize the vision of teaching and learning laid out in both NCTM's *Curriculum and Evaluation Standards for School Mathematics (1989)* and *Principles & Standards for School Mathematics (2000)*. Prior to the development and publication of the NSF-funded high school curricula, few could imagine how to enact the NCTM vision at the high school level. The Center has helped interested parties not only learn about the programs, but also better understand how to successfully implement them. COMPASS serves as a unique repository of knowledge for mathematics educators who are interested in improving high school mathematics education. COMPASS also provides a mechanism by which policymakers, funders, and publishers can learn from these innovative curriculum prototypes, thus informing the development of the next generation of mathematics curricula.

As the years go by, the growing collection of COMPASS-supported sites (and their successful implementation stories) provides a body of evidence that high school mathematics education can be something more than what most Americans have experienced to date.

Implications for Future Efforts to Improve High School Mathematics Education

In this section we provide our own interpretation of the significance of the COMPASS work and put forward potential implications for the design and funding of future efforts to improve high school mathematics education.

Curriculum-Centered Networks

In its current form COMPASS is pursuing a strategy that combines the strength of 1) well-designed educative curricular materials and 2) a national network capable of providing support to people as they address the challenge of implementing those materials. We believe that this improvement model is a strong, working example of what we have come to call a "curriculum-centered network approach." We also maintain that the strategy of a curricular-centered network is an important one to study due to its great promise for future efforts to improve high school mathematics.[22]

Understanding both defining aspects of a curriculum-centered network strategy is important. By this, we mean that it is critical to recognize the extent to which curriculum-centered networks use educative curricular materials as both the center-point of and primary vehicle for multiple aspects of the work needed to improve high school mathematics teaching. The very nature of networks, particularly those involving teachers and schools, makes them a particularly efficient and effective mechanism for mutual support and organizational problem-solving.

In our five curriculum implementation case studies (St. John, et. al., 2005), we saw firsthand the power of using a curriculum-led strategy to improve local high school mathematics teaching. The comprehensive, research-based programs included in the COMPASS effort are both educative and challenging; in this way they serve as potentially powerful vehicles for shaping the content and quality of instruction – even at the high school level, which has remained the most resistant to change. When the NSF-funded mathematics programs are implemented well and supported thoroughly, we encounter evidence of notable gains in the quality of teaching and the richness of the student learning experience. But such educative programs are neither easily implemented, nor readily sustained. With intention, educative materials are designed to be challenging and demanding – for teachers, for students, for administrators, and even for the broader community. They are meant to push on the boundaries of the system, to nudge it forward. This is where their power comes from and, simultaneously, where their vulnerability lies.

[22] A similar strategy underlies the work of the implementation and dissemination of the Interactive Mathematics Program. See http://www.mathimp.org/contacts/index.html) and its associated professional development network in California know as COME ON! See http://www.mathimp.org/publications/regional/california.html).

Thus, the highly innovative NSF-funded mathematics programs supported by COMPASS are not for everyone. They assume a shared institutional vision and a personal willingness to engage in seemingly radical changes in teaching and learning. Such wide-reaching, programmatic reform requires a decided level of readiness and commitment. Unlike the many "quick fixes" that are hoped for in educational policy circles, COMPASS curriculum implementation is inherently long-term, stay-the-course work—something that often runs counter to the current culture of public schooling and curriculum adoption cycles. Thus, the NSF-funded curricula are, in reality, not for all schools. For those that are ready and willing, COMPASS has been able to provide key supports along the way. And, because the supports that teachers, schools, and districts need to succeed are multi-faceted and tend to evolve over the course of the implementation effort, the COMPASS Center has had to learn and change along the way as well.

The most recent and highly promising strategy to emerge from the work of COMPASS is the COMPASS POINTS network. This approach creates a mechanism for members to learn from the experience of others and to contribute to knowledge of others in equal measure. We also find that particular challenges schools face in the complex process of implementing educative curricula are best addressed by a combination of inside and outside expertise. The inside expertise is made available by network members working with each other in appropriate and well-structured ways; the outside expertise (mathematicians, mathematics educators, evaluators, organizational development experts) can also be made available to all members of the network in a cost-effective fashion. In short, educative curricula pose very real and difficult challenges, that can be very rewarding to study and address; the network provides a structural mechanism and a shared culture that fosters productive collaboration directed towards resolving, or at least minimizing, these common issues.

Summarizing the Need for Curriculum Implementation Centers

The NCTM *Standards* (NCTM, 1989; NCTM, 2000) lay out a compelling vision for mathematics education. But that vision is not immediately or easily achieved. In fact, to achieve that vision on a significant scale in real classrooms all across the United States, multiple forms of support are needed. One key support is to be found in well-developed educative curricular materials. Such materials have to be significantly different from standard textbooks if they are to influence how mathematics is taught and learned. And yet, the more innovative the materials are, the less likely their chances of being successfully implemented. And even if adopted, they require adequate support. Without it, they risk being used poorly and counterproductive to student learning.

Hence, there is a need not only for well-designed materials but also for mechanisms that can help districts and schools adopt and implement the materials successfully. COMPASS

and the other curriculum implementation centers[23] funded by NSF have proven their ability to provide such supports. In fact, it makes little sense to fund highly innovative curriculum without investing in mechanisms to help in their successful use.

There are several design features that we believe contribute to the success of COMPASS. These design features could and should inform the design of future implementation Centers. COMPASS, as a Center, was defined by the following salient features:

- COMPASS provides a "neutral hub" that supports the dissemination and implementation of five different curriculum programs.

- COMPASS develops symbiotic relationships with the developers of each of the five programs.

- The COMPASS hub has high-level full time dedicated leadership that includes a professor of mathematics and a professor of mathematics education.

- COMPASS has developed strong connections to the national reform effort through NCTM, NCSM, MAA, and other national organizations.

- COMPASS has contributed significantly to the pool of national leaders capable of advancing mathematics education at the high school level. These leaders include teachers, administrators, curriculum developers, and higher education faculty.

- COMPASS has been able to assume a long-term perspective toward the improvement of high school mathematics and has evolved its strategies and activities over time, based on its experience and evaluation evidence.

After a decade, COMPASS has succeeded in contributing to what we call a "national improvement community" [24] for schools and districts dedicated to improving their high school mathematics programs. COMPASS offers a range of supports to those districts and schools that are willing to take on the challenges of implementing one of the NSF-funded high school mathematics programs. Growing a national network of such school leaders,

[23] For more on the role and efficacy of the *Curriculum Implementation Centers,* see the following Inverness Research reports: *The K-12 Mathematics Curriculum Center at EDC Cornerstone Claims*: http://www.inverness-research.org/abstracts/ab2003-03_Rpt_EDC_CornerstoneClaims.html and *The NSF Implementation and Dissemination Centers: An Analytic Framework*: http://www.inverness-research.org/abstracts/ab2001-12_Rpt_CIC_Framework.html.

[24] Engelbart, D.C. (1963). "A conceptual framework for the augmentation of man's intellect." *Vistas in information handling*, Howerton & Weeks (eds.), Washington, D.C.: Spartan Books, 1-29.

and connecting them to the curriculum developers, the COMPASS effort has begun to weave a web of relationships and connections that can help sustain the long and arduous process of program improvement in high school mathematics. In doing the work it has done, in developing the leadership that now inspires teachers, parents and administrators, and in creating strong relationships with national expertise, the COMPASS center has become a valuable national resource for challenging all the forces that conspire to preserve the status quo of high school mathematics education.

REFERENCES

Ball, D.L. & Cohen, D.K. (1996). Reform by the book: What it is – or might be – the role of curricular materials in learning and instructional reform? *Educational Researcher*, 25(9), 6-8.

Davis, Elizabeth A. and Krajcik, Joseph S. (2005). Designing educative curriculum aterials to promote teacher learning." *Educational Researcher, 34(3)*, 3-14.

Engelbart, D.C. (1963). A conceptual framework for the augmentation of man's intellect. *Vistas in information handling*, Howerton & Weeks (eds.), Washington, D.C.: Spartan Books, 1-29.

Ferrini-Mundy, J., Graham, K., Johnson, L., Mills, G. (Eds.). (1998). *Making change in mathematics education: Learning from the field.* Reston, VA: National Council of Teachers of Mathematics.

Fuller, K.A., St. John, M., Tambe, P., Evans, T., and Lopez, L. *The K-12 mathematics curriculum center at EDC: Cornerstone claims.* Inverness, CA: Inverness Research Associates, 2003. Retrieved from http://inverness-research.org/reports/ab2003-03_Rpt_EDC_CornerstoneClaims.html

Grouws, D. (Ed.). (1992). *Handbook of research on mathematics teaching and learning.* New York: Macmillan

Grubb, N.W. & Oakes, J. (2007). *Restoring value' to the high school diploma: The rhetoric and practice of higher standards.* Retrieved 11/7/07 from http://epsl.asu.edu/epru/documents/EPSL-0710-242-EPRU.pdf

Gutstein, E. & Peterson, R. (Eds.). (2005). *Rethinking mathematics: Teaching social justice by the numbers.* Milwaukee, WI: Rethinking Schools.

Hiebert, J., Carpenter, T.P., Fennema, E., Fuson, K., Human, P., Murray, H., Oliver, A., & Wearne, D. Problem solving as a basis for reform in curriculum and instruction: The case of mathematics. *Educational Researcher, 25*(4), 12-21.

Hirsch, Christian R. (Ed.). (2007). *Perspectives on the Design and Development of School Mathematics Curricula.* Reston, VA: National Council of Teachers of Mathematics.

Lave, J. (1992). Word problems: A microcosm of theories of learning. In P. Light and G. Butterworth (Eds.), Context and cognition: Ways of learning and knowing (pp. 74-92). New York: Harvester Wheatsheaf.

National Commission on Excellence in Education. (1983). *A nation at risk: The imperative for educational reform.* Washington, D.C.: US Government Printing Office.

National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics.* Reston, VA: National Council of Teachers of Mathematics.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: National Council of Teachers of Mathematics.

National Mathematics Advisory Panel. (2008). *Foundations for success: The final report of the National Mathematics Advisory Panel.* Washington, D.C.: U.S. Department of Education.

National Research Council. (1989). *Everybody counts: A report to the nation on the future of mathematics education.* Washington, D.C.: National Academy Press.

Paul, F. & Richbart, L. (1985). New York state's new three-year sequence for high school mathematics." In *The secondary school mathematics curriculum, 1985 Yearbook of the National Council of Teachers of Mathematics* (NCTM), Hirsch, C.R. (ed.). Reston, VA.: NCTM, 200–210.

Reys, R.E. (2001). Curricular controversy in the math wars: A battle without winners. *Phi Delta Kappan*, 83(3), 255-258.

Reyes, B.J., Reys, R.E., Chavez, O. (2004). Why mathematics textbooks matter. *Educational Leadership, 61(5),* 61-66.

Robinson, E., Robinson, M. & Maceli, J. (2000). The impact of standards-based instructional materials in the mathematics classroom," In *Learning mathematics for a new century,* 2000 Yearbook of the National Council of Teachers of Mathematics, Burke, M. (ed.), Reston, VA: NCTM, 112-126.

Schoenfeld, A. (2004). The math wars. *Educational Policy, 18(1)*, 253-286.

Simmt, E. (1997). Graphing calculators in high school mathematics. *Journal of Computers in Mathematics and Science Teaching*, *16*(2/3), 269-289.

St. John, M., Fuller, K.A., Houghton, N., Huntwork, D. & Tambe, P. (2000). *High school mathematics curricular decision-making: A national study of how schools and districts select and implement new curricula.* Inverness, CA: Inverness Research. http://www.inverness-research.org/abstracts/ab2000-01_Rpt_Compass_HSMathCurrDecisionMaking.html

St. John, M., Fuller, K.A., Houghton, N., Tambe, P. & Evans, T. (2005). *Challenging the gridlock: A study of high schools using research-based curricula to improve mathematics.* Inverness, CA: Inverness Research. http://www.inverness-research.org/abstracts/ab2005-10_Rpt_Compass_HSCurr-Multi-year-study.html

Schmidt, W.H., Houang, R., & Cogan, L. (2002). A coherent curriculum: The case of mathematics. *American Educator, 26(2),* 10-26, 47-48.

Steen, L.A. (2007, November). How mathematics counts. *Educational Leadership,* 65(3), 8-14.

Stigler, J.W., & Hiebert, J. (1999). *The teaching gap.* New York: Free Press.

Swafford, J.O., Travers, K.J., & Cooney, T.J. (1987). *The underachieving curriculum: assessing U.S. school mathematics from an international perspective.* Champaign, IL: Stipes.

Weiss, I.R., Pasley, J.D., Smith, P.S., Banilower, E.R., & Heck, D.J. (2003). *Looking inside the classroom: A study of k-12 mathematics and science education in the United States.* Chapel Hill, NC: Horizon Research.

Appendix A: Satellite Sites and Their Dissemination Strategies

- **Application Reform in Secondary Education (ARISE)**
  Mathematics: Modeling Our World (Southwestern Educational Publishing)

The ARISE project grew out of the COMAP tradition. For nearly 30 years, COMAP has produced dozens of applications-based "replacement units" for teachers of K-12 mathematics. It is not surprising, then, that the program produced through ARISE is a four-year curriculum with a strong focus on developing mathematical ideas through real-world contexts and problem solving. As part of its early dissemination strategy, the ARISE project held three Annual Institutes for Teachers which were funded in large part by COMPASS. These were 4-day institutes involving 50+ teachers. COMPASS funds were also used to support a cadré of teacher leaders who could work with individual schools and districts committed to implementing the ARISE materials.

- **Core-Plus Mathematics Project (CPMP)**
  Contemporary Mathematics in Context (Everyday Learning Corporation)

The Core-Plus curriculum, also a four-year program, was developed at Western Michigan University in Kalamazoo. All four courses feature interwoven strands of algebra and functions, statistics and probability, geometry and trigonometry, and discrete mathematics that build upon the theme of *mathematics as sense-making*. In terms of the early dissemination effort, Core-Plus focused much attention on working with people in educational leadership positions. Each year, they have offered a two-and-a-half day Core-Plus Leadership Conference aimed at exposing leaders to the curriculum and issues surrounding implementation. This year, Core-Plus staff combined the Leadership Conference with a Users Conference.

- **Interactive Mathematics Project (IMP)**
  Interactive Mathematics Program (Key Curriculum Press)

Development of the Interactive Mathematics Program actually began prior to the NSF curriculum development grant. An enthusiastic and committed group of teachers took the lead in designing the new curriculum, and played an integral role in writing as well as testing the materials from start to finish. A defining feature of the IMP materials is the organization of each unit around a central problem of practical and mathematical consequence. Thoroughly addressing the complex problem requires students to make use of many mathematical ideas simultaneously. Another hallmark of IMP is the program's commitment to supporting teachers through professional development. At the height of the dissemination effort, there were 13 regional IMP centers in the U.S. and Canada that together created a network of support for IMP teachers nationwide. COMPASS funds helped support the IMP centers that were not self-sustaining and to bring together all

regional center directors on an annual basis for 2-3 days of sharing strategies and lessons learned.

- **MATH Connections Project**
  MATH Connections: A Secondary Mathematics Core Curriculum

The MATH Connections Project was the only one of the five curriculum development grants awarded to a group with a private sector affiliation, the Connecticut Business and Industry Association (CBIA) Education Foundation. The textbook series that resulted is a three-year program designed to be a core curriculum for all students. Each of the three years is organized around a general theme: *Year 1 - Data, Numbers, and Patterns*; *Year 2 - Shapes in Space*, and *Year 3 - Mathematical Models*. The project had a small staff of only two people plus a part-time administrative assistant. Early adopters of MATH Connections were invited to attend Leadership Institutes for teachers and administrators that are partially supported by COMPASS.

- **Systemic Initiative for Montana Mathematics and Science Project (SIMMS)**
  Integrated Mathematics: A Modeling Approach Using Technology
  (Pearson Custom Publishing)

The SIMMS project began as part of the Montana State Systemic Initiative in 1991. The Montana Council of Teachers of Mathematics applied for the SSI and as a result, project leaders estimate that most high school math teachers in Montana during the period of the SIMMS development were involved in the project in one way or another. Among the five curriculum projects, SIMMS has had a reputation for having the most extensive technology connections and applications. It is also the only set of materials that is divided into six different levels or courses so that there are multiple four-year paths that students might take according to their success with the earlier courses and their post-secondary aspirations. The majority of the SIMMS dissemination work is accomplished by the director. A cadré of lead teachers, with the help of COMPASS funds, did training workshops in the summer. COMPASS funds were also used to produce a promotional video and a more detailed curriculum sampler that contains a few full modules from the text for teachers to try.

Appendix B: COMPASS Chronology

Date	Activity
1992-1997	NSF funds development of NCTM-oriented mathematics curricula for grades K-12 (five programs at the high school level)
1997-1998	COMPASS is funded by NSF to support implementation and dissemination (5 years)
1999	COMPASS contracts with Inverness Research Landscape Study of Mathematics Curriculum Decision-Marking
2000-2002 [NOTE: NCTM published its *Principles and Standards for School Mathematics* in 2000.	Inverness Research conducts COMPASS case studies - Bald Knob, Arkansas - Bellevue, Washington - Boston, Massachusetts - Harlandale, Texas - Ranum, Colorado COMPASS hosts Curriculum Showcases - Raleigh, North Carolina - Denver, Colorado
2002	COMPASS receives extended funding from the NSF
2003	La Jolla Planning Meeting - *considering the possibility of a COMPASS Network* - *identifying potential members* - *defining purpose*
2004	COMPASS Network Meeting in Washington, D.C. *official launching of the network – creating an identity*
2005	COMPASS Network Meeting in Monterey, CA *network goes to work – COMPASS POINTS becomes the name*

Date	Activity
2006	COMPASS POINTS Meeting in Golden, CO network takes action vis á vis NCTM's recent publication of K-8 Focal Points and word of a similar document for the high school level
2007	Work of COMPASS POINTS continues electronically

Appendix C: COMPASS Implementation Stories

Adapted from *Challenging the Gridlock: A Study of High Schools Using Research-Based Curricula to Improvement Mathematics* (2004) by Inverness Research[25]

Inverness Research began its multi-year study at about the time when the five NSF-funded high school mathematics curricula had first gone to full publication. Most 9th grade or Year One books were first available for purchase in the spring and summer of 1998, with the next book in each series appearing each subsequent year. This effectively meant that all five curricula were first available in their entirety in the fall of 2002. This was also a time when the use of non-traditional math programs was becoming a much more politicized issue across the nation. The "Math Wars" were well underway in reform-minded states such as California and organizations like "Mathematically Correct" had begun their attacks on any curriculum designed to reflect the vision of the NCTM *Standards* (Reys, 2001). Our data collection began in the midst of this turmoil, in the spring of 2001.

The Sites

The short descriptions below provide an overview of our five sites and a glimpse into the lives of the people, schools, and districts that we encountered over the course of our study. They are intended to provide brief context and background.

Core-Plus in Bellevue, Washington

Bellevue, Washington is a wealthy suburb of Seattle, where residents are accustomed to well-maintained school facilities, good teaching, and high student achievement. The district prides itself in being forward thinking and on the "cutting edge" when it comes to curriculum. So when Superintendent Riley demands that a single program be selected for use in all four high schools, district mathematics leaders suggest that math teachers choose from one of the five NSF-funded curricula. Even though elements of the decision feel rather top-down, teachers are involved in piloting units from all five programs and ultimately, in voting on their final selection—Core-Plus. Not everyone is initially pleased with the decision. However, enthusiastic leadership, combined with professional development for all those who want to participate and a supportive state context, continues to strengthen the effort. A trajectory of ever-improving test scores on the mandatory state assessment, particularly among traditionally lower achieving groups, also contributed to the staying power of Core-Plus in Bellevue.

[25] St. John, M., Fuller, K.A., Houghton, N., Tambe, P. & Evans, T. (2005). *Challenging the gridlock: A study of high schools using research-based curricula to improve mathematics*. Inverness, CA: Inverness Research. http://www.inverness-research.org/abstracts/ab2005-10_Rpt_Compass_HSCurr-Multi-year-study.html.

Mathematics: Modeling in Our World in Bald Knob, Arkansas

The Bald Knob story demonstrates how an innovative NSF-funded curriculum can serve as the driving force for strengthening and enriching the secondary mathematics core of a small rural district with only one high school – leading to the teaching of new topics, improved classroom practice, increased student interest, higher test scores, and more students completing advanced-level mathematics courses. It is also an example of how tenuous such innovation can be, especially when both the vision and leadership rest with a single person. Even when similar initiatives are underway at the middle-school and elementary levels, which were the case in Bald Knob, stewardship and passion for the high school reform effort must be widely shared by the group rather than tightly held by an individual. Some might argue that the Bald Knob High School Math Department did share a collective vision and support for the new program as a whole. However, a certain amount of resistance is a given at the high school level and in a department where two is the majority, the beliefs of a single staff member can completely change the tenor of the group. Under these circumstances, a challenging program like Mathematics Modeling our World (MMOW) can be as quickly dismissed as it is adopted.

Math Connections in Boston, Massachusetts

Boston's implementation of Math Connections illustrates the way in which curriculum can be a cornerstone of a far-reaching plan for comprehensive district-wide reform. According to Superintendent Payzant's vision, requiring the use of Standards-based curriculum and committing the resources to ensure that teachers are supported in doing so, can drive the systematic improvement of instruction – especially in a district which has been challenged to effectively serve underachieving students. However, because of the Superintendent's convictions and desire to effect change immediately, there is little time for teachers to 'buy in' to the specific program or the broader philosophy of integrated, Standards-based mathematics programs. The result is that for many teachers the curriculum is not a program but a series of related texts, and as such, can seem inadequate and even inappropriate for their often ill-prepared students – a fact that could hinder the district's plans for broader reform. Still, the district's own mandates and a high stakes state accountability system force people to take the curriculum seriously, and that may be the first step towards long-term instructional change.

Interactive Mathematics Program in Denver, Colorado

Ranum is a middle-class, suburban high school located north of Denver. This case illustrates the role that curriculum can play when teachers are highly motivated to change their practice. Spurred on by the publication of the NCTM Standards and early 1990s' reform-minded mathematics professional development, Ranum teachers seek

out and embrace the Interactive Mathematics Program (IMP) curriculum; it becomes a vehicle for their professional growth. According to the teachers, the curriculum helps them realize the potential and power of their own teaching and of their own students when grounded in a mathematically rich, constructivist program. The fact that Ranum's principal has a clear vision for program improvement and also for the growth of the Math Department helps the school foster a true mathematics education learning community. Still, this story also demonstrates the true vulnerability of a grassroots effort, and the extent to which strong curriculum is not necessarily sufficient to carry and sustain a change in culture. The success of IMP's implementation and its staying power at Ranum proves to be highly dependent on the support of the principal and the environment he has established within the school. When he leaves, a small-but-vocal group of parents gain an opening, and ultimately, the leverage they needed to topple the effort. However, there are residuals left behind and it is telling that Ranum ultimately chooses to implement Core-Plus as the replacement for IMP.

Systemic Initiative for Montana Mathematics and Science Project **in San Antonio, Texas**

In the Texas case, the story takes place in Harlandale, a low-income, largely Spanish-speaking suburb of San Antonio. It shows how an innovative math curriculum, such as Systemic Initiative for Montana Mathematics and Science Project (SIMMS), can serve as a central tool for much wider equity-based reform within a single school site and how another reform effort, such as the San Antonio Urban Systemic Initiative, can provide extra incentive to initiate the selection and implementation process. At Harlandale High School, the positive changes that teachers experience in their classrooms and among their students deepen their commitment to staying the course of implementation. However, breaking from the path of tradition and moving an entire school in a new direction takes more than high-quality curriculum and institutional will. Without the unyielding efforts of the Math Department chair, the dedicated support of the principal, and the careful selection of new faculty, there are simply too many prevailing forces that coalesce to thwart the effort. So far Harlandale has maintained a path of implementation that reflects constant vigilance, and the results speak for themselves.

While these brief teasers cannot substitute for the full cases, the summaries above give some sense of the rich cases we documented. A conscientious effort was made to carefully and accurately write down each story so that once finalized, after multiple reviews from our school and district participants, they could serve as the foundation for further research and comparison. Although they are now a piece of mathematics reform history, the COMPASS implementation stories remain timely to this day – two of the sites remain strong implementers of their COMPASS program.

Appendix D: COMPASS POINTS Network Foundational Beliefs

As members of COMPASS POINTS, a network of secondary mathematics teachers, teacher educators, administrators, educational researchers, and mathematicians, we share the following foundational belief statements.

1. **Learning:** Learning is complex, ongoing, and dynamic. Investing the time to understand students' formal and informal knowledge and habits of mind is necessary and foundational for learning and growth. Respect for students' thinking is central. Fostering positive dispositions toward mathematics and learning is essential. Examples include motivation, curiosity, risk-taking, and perseverance. Fostering good work habits is also important.

2. **Curriculum:** Curriculum plays an important role in developing students' mathematical competencies. Curriculum should engage students in worthwhile mathematical tasks that have multiple access points and incorporate higher-order thinking skills.

3. **Equity:** Knowing how to think analytically and to solve problems are attainable, teachable, and essential goals for all students. These goals must be an intentional component of a mathematics program: Mathematics teaching must develop in all students better processes of thinking, communicating, and uses of technology. Mathematics is empowering and impacts students' fundamental view of themselves; thinking of oneself as being good at mathematics is an avenue to empowerment in our society.

4. **Teaching**: Teachers need a variety of tools and strategies to reach all learners. Teachers must be flexible and willing to make adjustments in their teaching. Teachers should be committed to meeting students where they are and moving them ahead. Reflection on the practice of teaching mathematics is fundamentally important for the growth of teachers.

5. **Professional Development**: Strong, on-going professional development and collaborative networks of teachers are essential in realizing the goal of creating highly effective teachers, reflective practitioners and sustainable programs. Professional development goes beyond implementation of the curriculum in the classroom to include involvement of administrators, counselors, other teachers, students, parents, members of the community, and higher education faculty.

6. **Realizing Our Vision:** Successful implementation and sustainability of research-based curricula requires support from all stakeholders. Administrators, school leaders, university mathematicians, educators, and researchers alike—in addition to students, parents, and teachers—must work together to make this a reality.

Appendix E: COMPASS POINTS Letter to NCTM

October 21, 2006

Dear NCTM Board of Directors,

We are COMPASS POINTS, a network of high schools and educators committed to using and promoting the five integrated high school mathematics curricula developed with funding from the National Science Foundation – all research-based programs designed to embody the NCTM Standards. Each of our member schools has been identified as a strong implementer of one of the following NSF-funded programs:

Mathematics: Modeling Our World
Contemporary Mathematics in Context
Interactive Mathematics Program
MATH Connections: A Secondary Mathematics Core Curriculum
SIMMS Integrated Mathematics: A Modeling Approach Using Technology

Over the last few years, teams of teachers and administrators from each of our schools as well as individual math educators (professors of mathematics, professors of math education, district math leaders, etc.) have come together on an annual basis to learn from each other and to strengthen our work as stewards of the original NCTM Standards vision.

Recently we learned that the NCTM is considering a set of High School Focal Points similar to the recently published K-8 Focal Points. It is our collective belief that a set of year-by year Focal Points for grades 9-12 would be damaging and counter productive to all high school math reform efforts, but particularly those centered on furthering the NCTM vision for mathematics education. Below we list some of the key reasons we have chosen to taken this stand:

- The Focal Points do not include process standards – something we believe is critical in moving high school mathematics beyond the status quo.
- The multiple curricular options available at the high school level are not conducive to creating curricular goals for each grade level.
- The role of student and parent choice in determining the courses that students actually take poses an additional challenge.
- There is an inherent danger that a set of high school mathematics will inadvertently advocate for the traditional sequence of Algebra, Geometry, Algebra II, so on.

Over the course of the past ten years, we have seen our work as mathematics educators become increasingly contentious and political. Each of us is fully engaged, on a daily basis, in the effort to provide students with the kind of mathematics education that we know they deserve and that we ourselves were not fortunate enough to have. We have watched with dismay and disappointments as some of our colleagues, for a variety of reasons, have chosen to return to practices and curriculum that we long ago left behind. As indicated by our "foundational beliefs" (see attached), ours is a group dedicated to doing what is right, rather than what is easy. As our core professional organization, we would like to see the NCTM to do the same.

That said, should the NCTM choose to pursue the development of high school focal points, we urge you to consider the following recommendations:

- Any panel developing such a set of high school focal points should include high school mathematics teachers who have extensive experience teaching one or more of the programs named above.
- Any set of high school mathematics focal points should reflect the original NCTM Standards, upon which the NSF-funded curricula are based.
- Panel membership should also include college mathematics professors and mathematics education professors who support the teaching of NCTM standards-based curriculum.
- The focal point developers should guard against creating a product that has any possibility of being interpreted as advocating for the traditional high school mathematics sequence of Algebra I, Geometry, Algebra II, and so on.
- Any set of high school focal points should include a set process standards that articulate the mathematical habits of mind that we would like to see

We certainly hope that you will take our suggestions to heart. We welcome your questions and any future dialog related to our collective work. It is our hope that the COMPASS POINTS network can work more closely with the NCTM in future years. For we view good work of NCTM nearly two decades ago as the starting point of the ongoing work we strive to carry out. Please contact us with any questions or concerns you may have. We are ready to provide support and assistance in any way that we can.

In Partnership,

The Members of the COMPASS POINTS Network

Eric Robinson	Professor of Mathematics, Ithaca College, Ithaca, NY Co-Director, COMPASS Implementation & Dissemination Center
Margaret Robinson	Professor of Mathematics Education, Ithaca College, Ithaca, NY Co-Director, COMPASS Implementation & Dissemination Center
Marc A. Arredondo	Mathematics Teacher, Harlandale High School, San Antonio, TX
Scott A. Ballard	Mathematics Teacher/Dept. Chair, Lawrence High School, Fairfield, ME
Billie Bean	Mathematics Teacher & Dept. Leader, CE Jordan High School, Durham, NC
Michael A. Berube	Mathematics Teacher, West Valley High School, Yakima, WA
Karin Carson	Mathematics Teacher, Waunakee Community Schools, Waunakee, WI
Margaret DeArmond	California Co-Director, Interactive Mathematics Program Past-President of the California Mathematics Council
David DeLaby	Mathematics Teacher, California Academy of Math and Science, Carson, CA
Cynthia Francisco	Mathematics Teacher, Rock Bridge High School, Columbia, MO
Kasi Allen Fuller	Professor of Math Education, Lewis & Clark College, Portland, OR Senior Researcher, Inverness Research, Inc.
John Janty	Mathematics Coordinator, Waunakee Community Schools, Waunakee, WI Past-President of The Wisconsin Mathematics Council
Martha Mulligan	Mathematics Teacher/ Department Chairperson, Northside College Preparatory High School, Chicago, IL
Jamie R. Nordstrom	Mathematics Dept. Chair, West Valley High School, Yakima, WA
Regina Schwartz	Mathematics Teacher, Harry S. Truman H.S., Bronx, NY
Mario A. Rodriguez	Mathematics Teacher, Harlandale High School, San Antonio, TX
Aaron Weinberg	Assistant Professor of Mathematics, Ithaca College, Ithaca, NY
Jim Willis	Mathematics Teacher, Lawrence High School, Fairfield, Maine Math Consultant Kendall/Hunt