January 26, 2009

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The conclusions drawn in this report reflect the viewpoints of the authors. While there are many potential viewpoints, these reflect a systematic analysis of data by the authors. The hope is that these findings can facilitate improvement of this and related programs through open discussion and consideration of data-driven understandings.

This report is based upon work supported by the National Science Foundation under grant No. 07335500. It is also based upon data collected and analyzed initially with the support of the Board of Education of the City of Chicago including the Offices of Math and Science, High School Programs and Research, Evaluation, and Accountability, National Science Foundation under grant No 0085115, the Chicago Community Trust, Illinois State Board of Education, Illinois Board of Higher Education, James McDougal Family Foundation, Polk Brothers Foundation, Lloyd A Fry Foundation, The Boeing Company, BP Foundation, and Motorola Foundation.
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1. INTRODUCTION

In this Introduction we offer suggestions on how to navigate the document and then describe why and how we approach this study of systemic reform of K-12 math and science education in Chicago.

a. How to Navigate this Document

This paper is one part of a larger project that aims to use research and collaboration to address the complexities of systemic reform of math and science education in ways that are both illuminating and actionable. The larger project is the NSF 2007-2009 funded research grant to Loyola, UIC, and the Chicago Public Schools: Scale up of math and science K-12 education reform in a large urban district. The overarching goal of the project is to contribute to the capacity of urban school districts and educational researchers to work collaboratively in the effective planning, implementation, scale-up, adaptation, documentation and evaluation of systemic educational reforms, specifically in the area of math and science education. The project undertakes a multi-dimensional study of one such systemic reform effort: the 2002 – 2008 efforts of the Chicago Public Schools (CPS). Much of this reform effort is talked about by CPS insiders as the “Chicago Math and Science Initiative” and “High School Transformation Project.” This project draws on a collection of qualitative and quantitative longitudinal empirical data documenting the systemic reform over five years: from the stages of design, planning, and initial implementation through scale up and adaptation.

A key aim of this project is to integrate the scholarly and practice-based work of educational practitioners, policy makers, researchers, and evaluators in order to produce findings that are comprehensive, multidisciplinary and, most importantly, usable. The project brings together these stakeholders with the expertise needed to bring to bear the most relevant and up-to-date scholarship on educational systems reforms in order to: (1) analyze a unique body of longitudinal data in relation to key dimensions of the reform effort; and (2) present findings in usable formats to multiple audiences.

This document, Math and Science Education Systemic Reform in Chicago, 2002 – 2008, has been written by a team of individuals who have engaged in evaluation research and program planning of various facets of the Chicago reform efforts since 2002. By documenting key aspects of a complex mathematics and science reform as it evolves in a real setting, the aim of the document is to:

Help practitioners conceptualize systemic reform of math and science K-12 education through the real life experience of those engaged in Chicago’s efforts during 2002 to 2008

Help evaluators and researchers conceptualize areas of study to evaluate systemic mathematics and science reform initiatives

In order to optimize the accessibility and usability of this document by multiple audiences, the project team decided to produce the document in two formats: The document is available as a “paper” that can be read from front to back, and it is also available as a computer-based hyperlinked document. The audience for this document may wish to read it in its entirety or may examine its structure and then read the portions they find most relevant. Hyperlinks within the document will allow the reader either to see an overview of reform efforts or, by clicking on a link, to explore in more detail facets of particular activities in Chicago.
This paper is a “living” document. As such we aim to link it to other papers that we spin off of this work and that you, the reader, may suggest we add. It is also a work in progress and you will see points throughout the paper were we note that text is “forthcoming” in the future.

In Section 1, we begin by offering our reasons for undertaking this project. We then provide descriptions of the ways in which we have framed the issues addressed in this paper: through a systems diagram and conceptual framework, through stories about how reform activities played out in real life, and through descriptions of programs as they occurred over time.

In Section 2, we describe in detail the programs, policies, people and organizations integral to the accounts and stories of Chicago systemic reform in K-12 education.

In Section 3, we work to illuminate the working of this system of reform. We focus specifically on in-service professional development, coaching and leadership, content courses and programs, curricular materials and assessment systems within this large systemic reform effort. We examine accounts and stories of these reform strategies as they move from initial vision to activities that were implemented, adapted to their context, and sustained (or not).

Finally, in Section 4, we comment on some lessons learned about issues critical to the successes and challenges of math and science systemic reform. Section 5 is an appendix of various documents and data that serve to add further detail to the paper. Section 6 provides a list of references.

b. Understanding Systemic Reform in Chicago

Systemic reform of education involves a process over time through which sets of policies and practices aim to operate coherently to move interconnected resources and groups of people toward the provision of improved teaching and learning for all children. From the 1990s through the present, systematic education reforms have become increasingly adopted—particularly in US math and science education reform through the support of National Science Foundation (NSF) Statewide Systemic Initiatives, Urban Systemic Initiatives, Rural Systemic Initiatives, Local Systemic Change, Urban Systemic Programs, and Math Science Partnerships. Districts have also increasingly adopted systemic strategies, for example New York City’s Community District 2. Systemic efforts have also commonly referred to as standards-based reforms (Anderson et al., 2003; Chatterji, 2002; Supovitz & Taylor, 2005).

Between 2002 and 2008, the Chicago Public Schools (CPS) have clearly been engaged in a process of systemic reform of K-12 math and science education aimed at improving experiences and performances of their students and teachers. The following sections describing and analyzing CPS efforts will offer great detail on the aims and actions of this systemic effort. It has been an effort aimed at aligning policies and resources so to coherently drive the visions and actions of thousands of educators. It goes beyond a simple “program” of reform. One clue to the large scale and systemic nature is suggested by Supovitz and Taylor in their 2005 article. They explain that with systemic reform, it is not easy to answer the question: “What is the intervention here?” In this paper, we will take many pages, careful attention to detail and creative ways of organizing to describe the intervention given its systemic nature.1

---

1 We look at the systemic reform in math and science in CPS schools. There are also other more general reform efforts influencing CPS schools that are ongoing but outside of our inquiry. For example, there are efforts to close schools and recreate them as either new “small” schools and/or as “charter” or “contract” schools. Math and science education within these types of schools are influenced. However, these are not the focus of this paper, but it is important to keep in mind that
i. Why this Study Matters

This study makes contributions to a greater understanding of math and science education reform in a manner attentive in particular to three issues that are too seldom addressed in work on systemic reform, namely:

- Bridging the research and practice divide through dialogue,
- Complexities inherent in systemic reforms, and
- Grounding understanding in empirical longitudinal evidence.

Bridging the research and practice divide through dialogue

There is a need for research that addresses the complexity of science and math education reform efforts by looking not only at the impacts of the reform, but the processes by which innovations are used and brought to scale as well. (Hamilton et al, 2003). This calls for research and evaluation that combine summative (impact-focused) methodologies and analyses with more formative, process-oriented approaches (Nevo 2002). Those who attempt this integration of process and outcome emphases might have the opportunity for making a systematic effort to overcome the notorious theory/practice divide, and to apply educational theories (of learning, instruction, policy implementation, etc.) to educational practices of classroom instruction.

While most scholarly studies and summative evaluations of systemic reforms in math and science to date (some of which is referred to above) have been attentive to framing some of the complexities of systemic school reform efforts, they seem to be limited to covering just one or two dimensions of the reform. One factor contributing to these limitations is that most studies do not have access to rich, empirical data that documents the process of a reform effort across the many dimensions and stages of systemic change, from planning through inception to scale-up and adaptation. The second limiting factor is that, even in those studies that have a longitudinal range, the focus of the research or evaluation remains primarily summative, or impact oriented, focusing in particular on changes in student achievement.

There are few, if any, studies that are based on the analysis of data from the multiple dimensions of the systemic reform. Also absent from the literature are holistic, multidimensional studies of how such reforms evolve over time, scale up, and adapt to the dynamic conditions framing K-12 education. There is even less research that examines these facets of systemic reform and scale up in a way that effectively bridges the findings and perspectives of researchers and practitioners. And yet it is precisely this kind of practice-directed understanding that is most needed, not only for the ongoing improvement of existing reform efforts, but also so that the lessons learned by partners in current reform efforts can inform the planning and implementation of similar reforms nationwide.

In practice, many contextual factors cannot be directly controlled by the leaders of a systemic math and science initiative; rather, the interaction between district initiatives and the existing environment must be accounted for and built into policy. The development of sustainable K-12 math and science programs within the complex context of district life is dependent upon the collaboration of local educational communities to support ongoing reflection on the design, development and implementation of high-quality K-12 math and science programs. These factors call for multi-

the mathematics and science reform which is the focus of this work operates within a larger, frequently changing, CPS educational context.
dimensional research that examines and informs the ways school districts, universities and other institutions can most effectively partner to develop this capacity locally.

Evaluation research on Chicago Math and Science Initiative (CMSI) activities has been formative and responsive to meet the needs of CPS leadership between 2002 to the present. Now is an ideal time to immerse our research efforts to examine these key areas/nodes/issues with the critical depth and perspective that an outside, interdisciplinary dialogue could bring to the data and findings. Moreover, there is a need to inform the district’s theory of action in a systemic way and to relate what is happening in Chicago with the other districts involved in math and science reform. This project provides a timely opportunity for key partners in the implementation and assessment of Chicago’s math and science reform activities in elementary and high schools to accomplish this.

Complexities inherent in systemic reforms: The need for systems analysis of systemic reform

Documenting and evaluating such a large-scale systemic reform is a complex task. An overused, but still apt metaphorical question is: How do you eat an elephant? Answer: One bite at a time. This answer does identify the need to just get started and set manageable steps. However, it does not address where to start. Further, we are not “eating” anything; rather, we are seeking to understand the “whole” of the animal.

Others studying systemic education reform have pondered the question of how to examine a large scale, complex and dynamic systemic process. Supovitz and Taylor (2005) outline various approaches that they and others have used in evaluating systemic reform.

One approach is to examine just a particular facet of the reform. Some of this type of evaluation has been ongoing in Chicago as both internal and external evaluators have studied various components of the CPS math and science reforms. Evaluation of specific components of the effort has been useful in a formative way to those planning and implementing policies and events in Chicago. For example, an internal evaluation of a summer program for students entering high school and an external evaluation of algebra courses for 9th graders were done separately and used by program planners. However, connections between the studies—given the same students often took the summer school program and then went into algebra in the fall—were not made.

A second approach is to “decompose the key components of a systemic reform effort and to examine each component individually, such that the collective studies provide a concerted picture” (Supovitz & Taylor, 2005, p. 206). We (the authors of this paper) have been involved in this sort of effort around the evaluation of the different facets of the Chicago Math and Science Initiative (CMSI). Using an evaluation framework aligned to the CMSI theory of action, reports on professional development, instructional leadership, and teachers’ use of curricula have been generated across six years. While these evaluation efforts have been useful to district staff, they fail to document the systemic nature of the reform where all of these facets interconnect to each other.

A third approach is to “examine relevant components of an integrated system simultaneously” (Supovitz & Taylor, 2005, p. 206). This is what we are attempting to do and how we are shaping this paper. Going back to our elephant metaphor, awkward though it may be—this paper is based on evaluation and research that in the past has pulled the elephant apart and examined pieces of it (as in Supovitz and Taylor’s second approach). However, now in this paper, we are trying to piece it together and look at the whole of systemic reform efforts. We want to understand the ‘elephant’ in a more holistic manner.
The framework that we use in this paper to explore Chicago’s reform activities systemically is to look across “programs” and “policies” toward a more nuanced view of what contexts, visions and dynamics fuels the interactive nature of math and science education across time. While our framework differs, it does not contradict what the National Science Foundation’s Urban Systemic Program named as core drivers of the process of systemic reform: standards-based curriculum, policy changes, resource convergence and partnerships. However it does attempt to address these drivers in the context of an applied setting, analyzing the factors that must be attended to in the implementation of a large scale reform effort.

Grounding understanding in empirical longitudinal evidence

The sharing of knowledge about the “promising” practices of math and science systemic reform is often informal rather than systematic. This stems in part from a research context in which studies of the implementation of systemic reforms are generally not very rich or longitudinal in nature. This in turn is the result of a situation in which few systemic reforms manage to plan and begin strong evaluation efforts from the start of the effort.

Table 1 below summarizes a selection of the body of empirical data available to this project. The data listed are not just discrete pieces of insights collected each year but rather are longitudinal in nature. The longitudinal case studies of schools span across 5 years, with the sample of schools mirroring the district demographically. Much of the interview and observation data of teachers comes from within these case study schools, allowing for linkage of teachers’ beliefs and practices to contextual issues and student outcomes.
Table 1: Inventory of Selected CMSI Evaluation Data [Forthcoming… table to be updated]

<table>
<thead>
<tr>
<th>Year</th>
<th>System and District</th>
<th>School</th>
<th>Teachers *</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interviews &amp; Focus Groups: OMS Staff (# of staff)</td>
<td>Interviews &amp; Focus Groups: Instructional Leader Staff (Includes university instructors, school-based specialists, area coaches) (# of staff)</td>
<td>Longitudinal In-depth Case Studies: Studies of Curricula Implementation &amp; or Departmentalization (# of schools)</td>
<td>Interviews: Principals (# of staff)</td>
</tr>
<tr>
<td>2002-03#</td>
<td>20</td>
<td>9</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>2003-04</td>
<td>17</td>
<td>16</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>2004-05</td>
<td>34</td>
<td>32</td>
<td>14</td>
<td>48</td>
</tr>
<tr>
<td>2005-06</td>
<td>33</td>
<td>48</td>
<td>13</td>
<td>27</td>
</tr>
<tr>
<td>2006-07 ~</td>
<td>3</td>
<td>10</td>
<td>13</td>
<td>24+</td>
</tr>
</tbody>
</table>

# 2002-03 was a planning year for the CMSI and therefore the initiative had not been implemented in schools. Accordingly school data was not collected.

* District data on teachers is also available and will be used in this research.

~ Expected.

The data include not only quantitative and qualitative information about the process and impact of reform at many levels of implementation; they also contain evidence about the processes and impacts of collaboration between math and science educators, research communities, educational practitioners, and external and internal evaluators. Not only are the external and internal evaluation processes of the CMSI the vehicle by which data has been collected for this proposed research; these evaluation processes are also part of the design of the CMSI that has aimed from its inception to use ongoing documentation and formative evaluation to support dynamic and effective adaptation to changing conditions of reform. As such, the evaluation teams’ records of their interactions with CMSI stakeholders will also be part of the evidence used in analyses.

**ii. Framing the Study: A Systems Analytic View**

There has been an enormous amount of work done in Chicago between 2002 and 2008 to improve math and science education for students in the more than 600 Chicago Public Schools. This document does not provide accounts of all of these efforts. Rather, it frames the Chicago efforts in terms of the authors’ understanding of how multiple efforts have interacted as systemic reform. Then, because the full story of the reform’s systemic nature is still too vast, we focus our analysis primarily on district-level activities and how these have been enacted over time though we also discuss other levels of the system (e.g. area, school, classroom, and open-system). We analyze these activities in
relation to district visions for systemic reform, to the context of this unique system, and to the possibilities of sustainability of positive outcomes over time.

**Systems diagram**

The diagram below provides a simplified visual guide to the many types of organizations with resources and policies that influence the Chicago Public Schools district’s vision and enactment of math and science education. The top portion of the figure shows these organizations (as ovals) and uses arrows to suggest how funding, laws and policies, and materials flow toward the district. This context sets up how the district with its partners communicates a vision for change and implements systemic reform activities. The implementation is represented in the middle of the figure below. In Chicago’s case, there is a “core” vision seen throughout the various facets of the reform efforts. This vision shapes and is shaped by efforts to implement strategic activities (shown as diamonds). The central activities have not been envisioned nor enacted completely separate from each other. Nonetheless, examining them discretely provides a parsimony of analysis and reporting that is helpful in terms of making sense of this complicated reform system.

This reform vision and activity interacts and happens concurrently at district central offices, sub-district “Area” offices, school buildings and, ultimately, within classrooms. As this process occurs various types of information feed back to the organizations that set the context for this work. At the same time, information also feeds back among and between the different layers within the district itself (shown as red arrows). Feedback comes from formal channels as well as informal communication channels, and also from the findings of program evaluation and student assessments.

In order to complete this representation of the complex and multi-level system, we include a visual of the classroom, where students enter an instructional environment with teachers and with curricula (shown inside of a rectangle at the bottom of the figure). Finally, we note this is a system that is dynamic over time.
Figure 1: Systems Diagram Systemic Reform of Math and Science K-12 Education in Chicago

Context:
- Federal Govt
- DoE, NSF
- State Govt
- Universities
- Private Foundations
- Supply of Teachers
- Curriculum Developers
- Assessment Developers
- City Govt & Business
- District
- Contextual Lens/Inputs & Resources
- Vision and Implementation
- Implementation Lens/Process
  - Goal, Plan
  - Enactment
  - Outputs
- Central Offices
- Area Offices
- Schools
- Classrooms
- Classroom Lens/Outcomes with Impacts
- Temporal Lens/Sustainability Across Time
- Evaluation Feedback
- Assessment Feedback
- Political Feedback
- Curriculum
- Assessment
- University Courses
  - Content and pedagogical knowledge
- Materials
- Leadership / Administration & Coaching
- Policies
- In Service Professional Development
- Classroom Instruction
  - Students
  - Student Achievement
- January 26, 2009

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Conceptual framework

Related to the systems diagram in Figure 1 is our conceptual framework in Figure 2. The circled purple numbers show which sections of each figure relate to each other.

Figure 2: Conceptual Framework of Systemic Reform of Urban Math and Science Education

<table>
<thead>
<tr>
<th>Systemic Reform Context and Implementation</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contextual Level:</strong></td>
<td></td>
</tr>
<tr>
<td>Resources, policies, and instructional materials exchanged among federal, state, and city governments; universities, foundations, curricula and assessment developers, and publishers influence each other and the school district. Context also includes the external environment in which teachers and students live.</td>
<td></td>
</tr>
<tr>
<td><strong>Shared Vision:</strong></td>
<td>2</td>
</tr>
<tr>
<td>Exchange between context and district implementation is mediated by the district’s and system’s stakeholder perceptions of the vision for improved math and science education.</td>
<td></td>
</tr>
<tr>
<td><strong>District Implementation Level:</strong></td>
<td>3</td>
</tr>
<tr>
<td>District and partners carry out the vision through strategic activities that include:</td>
<td></td>
</tr>
<tr>
<td>* Recommendations and incentives for adoption by schools of standards-based curricula.</td>
<td></td>
</tr>
<tr>
<td>* Teacher professional development on use of curricula.</td>
<td></td>
</tr>
<tr>
<td>* In-school support of teachers by instructional leaders around use of curricula.</td>
<td></td>
</tr>
<tr>
<td>* Teacher professional development on content knowledge taught by mathematicians and scientists.</td>
<td></td>
</tr>
<tr>
<td>* Assessment tools for teachers’ use in understanding student learning.</td>
<td></td>
</tr>
<tr>
<td><strong>School Implementation Level:</strong></td>
<td>4</td>
</tr>
<tr>
<td>School principal and faculty perception of the vision for improved math and science education and participation in district implementation activities, including use of math and science activities different from those of the primary district vision.</td>
<td></td>
</tr>
</tbody>
</table>

Teachers’, Classrooms, and Students Within Systemic Reform

| Teachers’ Learning and Sense-making: |   |
| Exchange between district and classroom comes from what teachers learn from reform and other activities and what they deem important enough to act upon, mediated by the school implementation and contextual levels. |   |
| **Classroom Instruction Level:**      | 5 |
| Teachers and students using curricular materials engage in instruction--instruction being: |   |
| * Content, including accurate presentation of math and science concepts and presentation of the content that appropriately builds on the existing conceptions student have of the field. |   |
| * Structural components, including the order of units taught, length of time exposed to units, and use of which parts of curricula. |   |
| * Pedagogical components, including teacher moves of presenting information with a level of depth, embedding assessment of students in classroom activities and promoting student engagement. |   |
| * Student engagement, including staying on task, explaining understanding, and exploring. |   |
| **Students' Learning and Sense-making:** | 6 |
| Exchange between classroom and student achievement comes from what students learn from classroom instruction and what they deem important enough to act upon. This is mediated by the district implementation and contextual levels. |   |
| **Student Achievement:**              | 7 |
| Student evidence of learning on embedded and standardized assessments and student progress toward high school graduation. |   |
Focus on the Chicago Math and Science Initiative

In this document, we use the Implementation Lens (see Figure 1 and 2) to describe various levels of the district system and the math and science activities taking place. We do this with the recognition that we must set some realistic boundaries around what we can and cannot cover in one document. Yet we also consider to some extent the other layers of our systems diagram, the Contextual Lens and Classroom Lens, as they relate to the enactment of reforms.

We highlight how in the case of Chicago’s systemic reform of K-12 math and science education there are certain core goals influencing reform efforts. The ultimate goal is to improve student performance in mathematics and science as measured by test scores, grades, graduation rates, and college-going rates. The three long-term outcomes stated in 2003 at the launch of the Chicago Math and Science Initiative were as follows:

<table>
<thead>
<tr>
<th>Long Term Outcome 1:</th>
<th>Long Term Outcome 2:</th>
<th>Long Term Outcome 3:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improving instruction</td>
<td>Workforce development</td>
<td>Consistent policies</td>
</tr>
<tr>
<td>High quality classroom instruction in math and science will occur</td>
<td>Increased workforce capacity and competency in math and science content knowledge and pedagogy</td>
<td>Sustainable infrastructure (at school, instructional area, and district levels) and coherent policy directives in math and science will be created</td>
</tr>
</tbody>
</table>

Created and enacted in relation to these goals are five types of strategic initiatives to provide:

- In-service Professional Development
- In-School (Human) Supports for the Improvement of Teachers’ Curriculum Use and Instruction
- Content Knowledge Depth in Math and Science for Teachers
- Curricular Materials that are Standards Based
- Assessment Systems.

We represent this level roughly in the diagram above as the implementation lens. With a bit more elaboration, we can also conceive of this level of the systemic reform efforts as resembling an atomic structure that could be represented much like Bohr’s planetary model of the structure of an atom. We know that the systemic education reform underway is much more complex than this model—just as we know that atoms of matter are more complex than Bohr’s early model. However, this sketch offers a way to help us visualize some facets of education reform that we see as essential to understand what has been happening in Chicago from 2002 to 2008 in math and science K-12 education.
Analytic framework for this paper

We frame our analysis of strategic reform activities in this paper to focus on mechanisms that have improved (or failed to improve) math and science education and its outcomes in Chicago. Accordingly, for each strategic activity strand discussed in this document, we ask and address the following questions around context, vision, and sustainability:

**Context**

What contextual factors was the reform strategy designed to take into account and/or directly address, and how?

As the reform strategy was enacted, what contextual factors impinged and/or facilitated the enactment of the reform?

**Vision**

How was the reform strategy envisioned to respond to key reform goals of:

- Consistent policies,
- Workforce development, and
- Improved instruction?

How has the enactment of the reform strategy affected the above key reform goals?

**Sustainability**

How was it expected, initially, that the reform strategy would attend to the initiative’s goal of sustainable reform?

As it was enacted, how did the strategy contribute to sustainability of the reform?

How did the desire for sustainability influence the strategy: Its guiding assumptions? Its programmatic efforts? Its use of resources?

What challenges has the strategy faced in its efforts to contribute to the goal of sustainable reform?
Elaborating on the analytic framework

Public schools and educational reform initiatives interact within a broader context or network of governmental units, postsecondary institutions, cultural organizations, philanthropic foundations, other partner organizations, and the public at large including various community groups. Understanding reform efforts thus requires analysis that considers how the reform initiative is influenced by, and impacts upon, people and organizations outside of the formal organization of the district. Our analysis for the project will use an open-systems level perspective that not only looks at the levels of reform within the district and schools organization, but also beyond it. An open-systems perspective focuses simultaneously on what is happening in the school and what is influencing the school. It focuses not only on what is happening within the district and within the organization of the school but also on those systems outside of these that influence them. Such a perspective acknowledges the fact that schools and districts are not closed systems and face multiple influences and pressures from a variety of stakeholders outside of their system. Federal and state policies are critical influences.

Analyzing educational reforms also requires a district-level approach. A district-level perspective will focus on, and take into account, the particular contexts of a district—knowing that all districts differ. Studying at the school-level is also critical. How are teachers influenced by reform efforts and how does this influence relate to their instructional practices in math and science classes? In this document, we analyze teacher activities, resources, tools and instructional practices related to professional development for teachers through workshops; programs for teachers to gain endorsement in math or science; and teachers’ use of curricular materials in math and science that their schools require them to implement. Children, their parents and communities are influenced by the educational reforms and the changes in how math and science are taught. In this paper we look at issues like parents’ experiences supporting students and teachers’ views of parental support; evidence of impacts of new practices on student learning and achievement; and how the initiative serves students with exceptionalities, for example children with disabilities or those learning English as a second language.

Moving from initial visions of school reform to the enactment of programs and policies at the district scale can be seen as a process of evolution that begins at the point of program inception. Improving math and science instruction on a small scale with several teachers or schools differs greatly from making changes that impact a whole school district. And yet even when individual teachers begin using new math curricula, the process is one of “adaptation” not “adoption.” A number of studies have worked at “unraveling this dilemma” by “exploring in detail the types of adaptations teachers tend to make, the reasons behind those adaptations, and when in the planning and instructional process such adaptations occur” (Drake & Sherin, 2006: p 183; Spillane, 2000). Yet it is that type of understanding that is at the heart of whether the larger scale reform effort will work. These adaptations also are too seldom studied beyond the individual teacher and connected to their organizational context (Stein & Coburn, 2006). There is a need to understand how the adaptations move to scale (Elmore, 1996) as well as a need to discern more precisely what “scale” means. Coburn (2003) makes the point that if “scale” is to be sustained, it needs to be considered as more than just a numeric count of who is “implementing” but needs to consider the depth, sustainability, spread and ownership around the reform efforts.

By definition, systemic reform of education involves developing coherence and aligning resources across complex educational systems (Supovitz & Taylor, 2005; Anderson, Brown & Lopez-Ferrao, 2003). Often this coherence is described as the alignment of standards, curricula, and assessments by
states and districts (Smith & O’Day, 1990), by schools themselves (Newmann, Smith, Allensworth, & Bryk, 2001), or some combination of an outside-in and inside-out approach (Fullan, 1994) in an attempt to mitigate a heightened state of policy incoherence (Fuhrman, 1993).

As Coburn (2003) has emphasized in her scholarship, sustainability is a facet of reform that must be attended to. The conditions under which an educational reform was launched differ from current conditions—with next year promising to bring even more changes in the personnel, policies, funds and politics in play. Understanding a reform effort requires close attention to how the initiative deals with consistency and flexibility given the dynamics of change, its emphasis on collaboration and coherence among partners, and its focus on sustainability.

The key to successes and challenges of math and science reform rests with the teachers and, in particular, whether and how the structure and culture of their workplace allows and encourages them to think, act, and learn as individuals and within a group (Cummings, et al., 1985; Elmore, 2004; Gitlan & Margonis, 1995; McLaughlin, 1976; Stein & Coburn, 2006). Teachers’ beliefs and practices are impacted by issues that do not reside only with them or with their students, but which have their roots in the complex layers of school-level and district-level spaces, as well as open systems outside the district organizations’ activities. These include many issues that scholars and policy makers identify as political issues and challenges to reform (McDermott, 2000; Fuhrman, 1994; Heck & Weiss, 2005; Kaser et al., 1999). True reform rests with teachers who are heavily affected by a range of psychological, situational, and institutional factors (that are not always easily identifiable or predictable in their effects).

iii. The Parallel Need for Programmatic, Temporal, and Evolutionary Views

Large scale systemic reform is complex and cumbersome to describe through a systems analysis that highlights the interrelationship among facets of the work. Yet we think it is essential to do this and present this at the start of this document. However, there is also great value to doing a more traditional description and listing of the programs that make up the reform efforts and of the organizations and historical evolutions over time. We will describe Chicago’s math and science reform efforts in these terms in Section 2.

iv. Considering Short and Long Terms Outputs, Outcomes, and Impacts

In the Chicago math and science education programs we describe in this paper, the ultimate goal was that students benefit in ways that would increase their mathematics knowledge and science literacy. The indicators of student learning progress used most frequently have been student standardized test scores, but sometimes grades or on-track to graduation rates. The Illinois State Achievement Test (ISAT) is the state criterion-referenced assessment covering primary, middle and high school grades. (See http://www.isbe.state.il.us/assessment/ISAT.htm for details on the ISAT).

Across 2002 and 2008, there were positive trends in CPS student achievement in math and sciences.
Table 2 CPS Student Performance on State Criterion-Referenced Assessment (ISAT)
Percentages of students who met and exceeded state standards in math and science

<table>
<thead>
<tr>
<th>Subject</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd grade</td>
<td>37%</td>
<td>46%</td>
<td>46%</td>
<td>49%</td>
<td>56%</td>
<td>55%</td>
<td>67%</td>
<td>70%</td>
<td>71%</td>
</tr>
<tr>
<td>5th grade</td>
<td>28%</td>
<td>32%</td>
<td>36%</td>
<td>44%</td>
<td>51%</td>
<td>50%</td>
<td>59%</td>
<td>66%</td>
<td>69%</td>
</tr>
<tr>
<td>8th grade</td>
<td>20%</td>
<td>25%</td>
<td>31%</td>
<td>31%</td>
<td>33%</td>
<td>32%</td>
<td>38%</td>
<td>65%</td>
<td>71%</td>
</tr>
<tr>
<td>11th grade</td>
<td>N/A</td>
<td>26%</td>
<td>26%</td>
<td>27%</td>
<td>27%</td>
<td>27%</td>
<td>30%</td>
<td>29%</td>
<td>na</td>
</tr>
<tr>
<td>4th grade</td>
<td>33%</td>
<td>36%</td>
<td>39%</td>
<td>40%</td>
<td>41%</td>
<td>44%</td>
<td>57%</td>
<td>57%</td>
<td>60%</td>
</tr>
<tr>
<td>7th grade</td>
<td>47%</td>
<td>52%</td>
<td>53%</td>
<td>56%</td>
<td>56%</td>
<td>55%</td>
<td>69%</td>
<td>63%</td>
<td>65%</td>
</tr>
<tr>
<td>11th grade</td>
<td>N/A</td>
<td>20%</td>
<td>22%</td>
<td>23%</td>
<td>27%</td>
<td>26%</td>
<td>24%</td>
<td>25%</td>
<td>na</td>
</tr>
</tbody>
</table>

At times, various stakeholders in the Chicago systems reforms have linked the student trends with the activities of various math and science reform programs. The CPS Office of Mathematics and Science noted in their 2006 final report of their National Science Foundation-funded Urban Systemic Program that “continued exposure to CMSI programs does appear to have a cumulative, positive effect on student achievement” (Feranchak, CUSP Final Project Report, 2006, p.30). They based this conclusion on two different analyses: one where schools using CMSI supported curricula showed higher percentage gains in their ISAT scale score from 2003-2004 to 2004-2005 and second where schools whose teachers had high attendance in CMSI professional development sessions showed more positive one-year change in the percent of students meeting or exceeding state standards on the ISAT math or science tests.
Figure 4 Percent of schools gaining in their ISAT scale score from 2003-2004 to 2004-2005

![Percent of schools gaining in their ISAT scale score from 2003-2004 to 2004-2005](image)

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Non-Implementing Schools (N=236*)</th>
<th>1st year implementing schools (N=103)</th>
<th>2nd year Intensive schools (N=78)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd grade math</td>
<td>47.2</td>
<td>52.0</td>
<td>59.0</td>
</tr>
<tr>
<td>5th grade math</td>
<td>42.4</td>
<td>46.7</td>
<td>63.3</td>
</tr>
<tr>
<td>8th grade math</td>
<td>40.7</td>
<td>34.1</td>
<td>44.7</td>
</tr>
<tr>
<td>4th grade science</td>
<td>55.7</td>
<td>51.9</td>
<td>57.2</td>
</tr>
<tr>
<td>7th grade science</td>
<td>48.0</td>
<td>39.5</td>
<td>51.9</td>
</tr>
</tbody>
</table>
Throughout this document, when available, we will report student outcomes that may be related to specific math and science reform activities. However, we will refrain from delving into whether these student achievements can be claimed empirically as resulting from various activities.

In this study, rather, we will focus on outputs, outcomes and some impacts of the reform effort on the teachers, administrators and other stakeholders.

Figure 4 Relationship between CMSI professional development attendance and student ISAT performance
2. MATH AND SCIENCE EDUCATION REFORM: HISTORY, ORGANIZATIONS, PROGRAMS, POLICIES, EVALUATION, LOGIC

Later in this paper (Section 3), we present the 2002-2008 math and science K-12 education reform in Chicago from a holistic systemic perspective using a specific analytic framework. However, in order to have the background to engage critically with that approach, it is important have a rich understanding of the story of how the reform efforts developed, the contexts they engaged with, and the evaluation work that has informed the efforts over the course of their development. In this section, we look at these math and science reform activities from the perspectives of:

- The context of Chicago school reform
- Organization structures engaged
- Descriptions of key programs and policies
- Evaluation studies focused on these activities
- Logic models created to describe these activities.

a. Chicago School Reform across Time

We highlight briefly key moments in the recent history of Chicago Public Schools that shape the context of the math and science education practices and policies we focus on from 2002-2008.

i. Reform History

The state of education and overarching reform efforts in the Chicago Public Schools (CPS) have been studied and publicized for decades. There has been great interest in CPS as the third largest in the United States with more than 400,000 students and 24,000 teachers and 600 elementary and secondary schools. Eighty-five percent of the children served by CPS come from low income families. (See [http://www.cps.k12.il.us/AtAGlance.html](http://www.cps.k12.il.us/AtAGlance.html)). Studies have chronicled the district’s experiences moving through recent reform phases with influences that continue in the present. These reform phases and influences include:

- The Chicago School Reform Act as 1988 State of Illinois legislation. This Act granted local control of CPS schools to community school councils and principals. Individual schools have significant authority for making most curricular, policy, resource, and partnership decisions. The local authority is shared by each school’s principal, teachers and Local School Council comprised primarily by parents, as well as teachers and representatives of the local community. (For an overview see [http://www.catalyst-chicago.org/guides/index.php?id=77](http://www.catalyst-chicago.org/guides/index.php?id=77)).
- Institutionalized mayoral control over the district beginning in 1995 with mayoral appointment of district chief executive officer (CEO). CEO and mayoral priorities in the late 1990s were on centralization focused on literacy, high stakes testing and ending social promotion. Since 2002, leadership and structures within the district have been undergoing changes and focused on instruction and school choices around instruction. (For an article on Chicago’s mayoral control of public education see a New York Times article at
January 26, 2009

The 1998 Corey H. v. The Chicago Board of Education lawsuit settlement backed by the federal Individuals with Disabilities Act of 2005. These require that students with disabilities spend as much time as possible with non-disabled students and have access to the same curricula. (See Illinois State Board of Education guide to Corey H requirements at http://www.isbe.state.il.us/coreyh/default.html).

Federal No Child Left Behind (NCLB) legislation passed in 2001. This legislation influences CPS policies around determining accountability standards for schools and for teachers. (For the US Department of Education home page on NCLB got to http://www.ed.gov/nclb/landing.jhtml).


In 2001 and 2002, the Chicago Public Schools made many leadership and policy changes. During the summer 2001, the mayor appointed a new School Board President, Michael Scott, and a new Chief Executive Officer, Arne Duncan. Duncan selected Barbara Eason-Watkins as the districts’ Chief Education Officer. Among the changes they announced in their first year were the following:

- Reorganization of the regional office structure from 6 regional offices to 24 Area Instructional Offices to provide more supervision and support for schools. (See http://www.oism.cps.k12.il.us/aio.shtml).
- A new $31 million Chicago Reading Initiative calling for all elementary teachers to devote 2 hours daily to literacy with the support of reading specialists from the central office and funds for classroom libraries. This effort also involved high schools. (See http://cri.cps.k12.il.us.)

Within that year US President George Bush signed into law the No Child Left Behind Act (NCLB) of 2001 which focuses attention on, among other things, teacher quality (i.e. qualifications or credentials). City and national press attention highlighted problems in teacher quality in Chicago. An investigative report found that over five thousand Illinois teachers failed at least one of the tests required for Illinois teacher certification. While the majority of these teachers eventually passed, those who had failed the exams were likely to be hired at schools with high poverty rates, low test scores and high enrollment of students of color. Illinois had the worst teacher-quality gap in the country, with at least half of the state's high-poverty and high-minority schools (many in Chicago) employing teachers who did not have credentials in the subjects they were teaching. CPS announced findings of its own study -- that one in every five teachers in the district’s worst schools (81 on probation) lacked full credentials. Duncan’s administration addressed these teacher quality concerns with new CPS policies that

- Banned the hiring of teachers without proper credentials
- Gave uncertified teachers a deadline of two years to get certified

Compared to national and state performance levels, Chicago elementary and high school students were not achieving well in math, science, or reading. For example, in math on the Illinois Standards Achievement Test (ISAT) only a quarter of Chicago grade 8 students met or exceeded standards compared to half of all Illinois eighth graders. These numbers are even more discouraging when
disaggregated with only 21% of the students on free lunch and only 16% of African American students who met or exceeded math standards.²

**ii. Chicago Math and Science Education, Pre-2002**

In this section we begin by briefly reviewing the pre-2002 history of Chicago math and science education. We then describe the broad components of math and science reform efforts, starting with the funding of the Chicago Urban Systemic Project (CUSP), creation of the CPS Office of Mathematics and Science (OMS), its Leadership Academy, and its launch of the Chicago Math and Science Initiative (CMSI).

There are multiple programs and strands of the initiative that are key to understanding the context of math and science education reform in elementary schools and in high schools, not all of which can be addressed in this paper. In terms of elementary schools, we highlight the following program components that have been rolled out over the years: CMSI-supported curricula and professional development for these curricula; schools initially volunteering and then being selected to use these supported curricula (known as Intensive Support Schools); human resource supports including Facilitators, Coaches and Specialists; university-based math and science courses for teachers; support for grade 8 algebra; Benchmark Assessment tools created specifically for CPS; and the Cluster 4 Middle Grades Project. At the high school level, the components of reform programs we highlight include: the process of selecting curricular texts around which to build district supports; Double Period Algebra for grade 9; intensive support for volunteering schools in the High School Transformation (HST) project; instructional leaders like Area and University Coaches; and new assessment tools developed for the HST. These program descriptions set the stage for the analytic discussion that follows in the later chapters.

**CPS mathematics and science prior to NSF support (pre-1994)**

Systemic reform of math and science education in CPS must be viewed through the lens of the Chicago School Reform Act, the landmark 1988 legislation that ceded decision-making authority on many issues, including curriculum, to local governing boards in each of Chicago’s approximately 600 schools. By September 1994, when NSF approved an Urban Systemic Initiative (USI) award to CPS, the impact of Chicago’s dramatic movement to site-based management was being felt on a number of levels. Under the assumption that local school sites were the primary decision makers regarding curriculum, there was only minimal, if any interest among the district’s upper management in any new curriculum initiatives. The district’s curriculum office and curriculum support structure had largely been dismantled, with only a skeleton staff remaining. Significantly, there was little district effort to align district or school instructional decisions with national and state mathematics and science standards or to the emerging State of Illinois school accountability system. With local schools making individual decisions about curriculum and instruction, new district-level leadership or direction for mathematics/science were not evident.

Local schools that wanted support for mathematics and science improvement were forced to rely largely on expertise and resources from outside of the school system. Typically this support was provided by universities with their own NSF awards or not-for-profit organizations and other funders.

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² See Appendix d for additional detail on late 1990s and early 2000s contextual data around student achievement in math and science in CPS schools.
who were committed to Chicago Public Schools. These funded projects could be solid programs but there was little connection between the different projects and no systemic support for them. The outside groups supporting the individual schools also had the capacity to support only a relatively small number of schools. This left most schools struggling individually on mathematics and science instructional improvement.

Hence, the 1994 NSF USI award to CPS represented an emerging view within the district of the need to reassert district leadership related to a number of issues including setting core expectations for curriculum and accountability for student achievement in mathematics and science. Soon after the award was made, the Mayor of the City of Chicago was given authority to run the city’s public school system.


The Urban Systemic Initiative (USI) was a grant from the National Science Foundation to CPS. The program, which was initiated in 1994, promoted the reassertion of district leadership in mathematics and science and the reemergence of district strategies for improving mathematics and science achievement. Under the USI, CPS standards for mathematics and science were developed for all grades and high school graduation requirements in mathematics and science were significantly strengthened to include three years of credit in both mathematics and science. The new CPS standards were designed to help align CPS curricula with State of Illinois and national standards for mathematics and science instruction. The strengthened graduation exceeded existing State graduation requirements at the time.

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3 Examples of these types of partners include the Teachers Academy for Math and Science Education or TAMS which had NSF and state funding and the Chicago Annenberg Challenge with the support of the Annenberg Foundation.

4 The subsection on the Urban Systemic Initiative draws on a description by CPS staff leading the post-2003 Urban Systemic Program and new CPS Office of Math and Science. In the next subsection on the early Chicago Urban Systemic Program pre-2003, we provide some reports about the CSI from the perspective of the pre-2003 leadership team. Additional analysis and data recovery is needed to compare and contrast the views of these different leadership groups and the influences of these programs.

5 Prior to 1988, the district had much stronger central control over curricular and human resource decisions in schools. Dissatisfaction with these central policies was a factor in the 1988 Illinois State law giving schools local control. An analysis of these pre-1988 policies in comparison to 2002-2008 reform would be fascinating but is outside the scope of this paper.

6 A decade after CPS increased its high school graduation requirements, the Illinois State Board of Education finally increased mathematics graduation requirements for all Illinois schools in 2005 to three years for 2009 graduates, with no specific courses required; science graduation requirements will increase from the current one-year State requirement to two years for 2011 graduates.
Other significant CPS policy changes included the elimination of remedial high school mathematics and science courses and the adoption of a tough, no-social-promotion policy, in which students who performed significantly below grade level on the Iowa Test of Basic Skills (ITBS) were placed in mandatory after-school and summer programs and retained in targeted grades if they did not show sufficient progress.

The USI also enabled the reestablishment of the district’s leadership in mathematics and science, allowing the district to employ a cadre of support personnel who advised local schools on key mathematics/science-related decisions and developed programs to support local efforts. USI personnel focused primarily on site-based decision making related to mathematics and science. USI leaders created programs that helped teachers and administrators develop a deeper understanding of new standards for excellence in mathematics and science instruction and consulted with schools as they made decisions about curriculum and professional development. A menu of programs that highlighted best practices in mathematics and science was created from which schools would identify workshops that aligned with their needs.

A model for the USI award was developed by school-based mathematics and science “design teams,” aimed at providing “incentive awards” to local schools. These incentive awards, typically of $5,000-$10,000 each, supported locally developed initiatives related to the school’s mathematics and/or science programs. USI personnel reviewed the award proposals, approved the spending plans, and monitored implementation. Local schools were required to match funding from the NSF award with expenditures from local discretionary funds. Over the course of the 5-year award project, over two thirds of the district’s schools were awarded at least one incentive award and served as the unit of change for the district.

The local incentive awards typified the tension felt by USI leaders between the need to provide district leadership, and a desire to support the site-based decision making authority of individual schools. The struggle to find the right balance between central and local decision-making persists to this day. With the NSF-supported incentive awards, USI leaders provided parameters for the incentive awards but individual schools determined their own priorities and designed their own programs. The awards were used for a wide range of purposes related to mathematics and science—all related to professional development for teachers. The allocation of award resources to support local efforts was viewed by the USI leadership as a key way to focus local school efforts on substantive mathematics and science improvement efforts and was greatly appreciated by local school leaders. Analysis done for NSF annual reports confirmed that significant amounts of funds were leveraged for mathematics and science improvement from local school budgets as a result of the incentive awards.

<table>
<thead>
<tr>
<th>Changes in High School Graduation Requirements</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-USI</strong></td>
<td><strong>Changes during USI (1995)</strong></td>
</tr>
<tr>
<td>Mathematics</td>
<td>Three years, including one year each of algebra, geometry, and advanced algebra with trigonometry</td>
</tr>
<tr>
<td>Two years</td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>Three years of laboratory-based courses, including one year of life science (e.g. biology), one year of physical science (e.g., physics or chemistry), and one year of earth/space or environmental science</td>
</tr>
<tr>
<td>One year, no specific course requirements or laboratory requirement</td>
<td></td>
</tr>
</tbody>
</table>
Results in student achievement test results (see Table below) were cited by the USI project to confirm that consistent and specific academic standards, strengthened policies, university partnerships, and increased attention to best practices in mathematics and science had a positive impact on student achievement. Among other lessons learned, the USI noted the continuing need to deepen the mathematics/science leadership capacity and content knowledge of the district’s mathematics and science teachers. Building that capacity became the focus of the Urban Systemic Program (USP) proposal submitted to NSF from CPS in 1999.

Table 3: Iowa Test of Basic Skills Results in Mathematics for Grades 3 through 8 Combined, 1997-2005

<table>
<thead>
<tr>
<th>Year</th>
<th>Number Students Reported</th>
<th>Bottom Quartile</th>
<th>Quartile 2</th>
<th>Quartile 3</th>
<th>Top Quartile</th>
<th>% At/Above National Norms</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>153,784</td>
<td>25.1</td>
<td>29.6</td>
<td>25.1</td>
<td>20.2</td>
<td>46.6</td>
</tr>
<tr>
<td>2004</td>
<td>158,444</td>
<td>22.7</td>
<td>31.3</td>
<td>27.0</td>
<td>19.1</td>
<td>47.5</td>
</tr>
<tr>
<td>2003</td>
<td>159,784</td>
<td>22.8</td>
<td>30.3</td>
<td>27.5</td>
<td>19.4</td>
<td>48.3</td>
</tr>
<tr>
<td>2002</td>
<td>157,124</td>
<td>23.6</td>
<td>30.8</td>
<td>26.9</td>
<td>18.7</td>
<td>46.9</td>
</tr>
<tr>
<td>2001</td>
<td>153,301</td>
<td>25.9</td>
<td>31.9</td>
<td>25.4</td>
<td>16.9</td>
<td>43.7</td>
</tr>
<tr>
<td>2000</td>
<td>151,695</td>
<td>24.1</td>
<td>31.2</td>
<td>26.0</td>
<td>18.7</td>
<td>46.1</td>
</tr>
<tr>
<td>1999</td>
<td>148,319</td>
<td>26.8</td>
<td>30.5</td>
<td>24.7</td>
<td>18.0</td>
<td>44.0</td>
</tr>
<tr>
<td>1998</td>
<td>151,145</td>
<td>31.0</td>
<td>30.8</td>
<td>23.3</td>
<td>14.9</td>
<td>39.5</td>
</tr>
<tr>
<td>1997</td>
<td>147,293</td>
<td>35.1</td>
<td>29.0</td>
<td>21.2</td>
<td>14.7</td>
<td>37.0</td>
</tr>
</tbody>
</table>

At the same time, however, dispersing USI funds in relatively small amounts to hundreds of individual schools may have diluted the strategic impact of the NSF funds. Furthermore, in supporting local decisions involving mathematics and science and not being more aggressive in promoting a specific district-wide vision for mathematics and science instruction, the USI did little to slow the splintering of mathematics and science instruction into a collection of individual, school-based programs. By the end of USI funding in 1999, and after nearly a decade (1989-1998) of site-based decision making about curriculum, individual schools were using dozens of mathematics and science textbooks and other instructional materials, making curriculum-specific support next to impossible by the USI team.

Urban Systemic Program (Early years 2000-2002)

According to district math and science leaders writing about the first year of the CUSP program in 2000, “prior to 1994,” the district’s math and science infrastructure was “fragmented and unfocused.” By 1999 (the end of the CSI grant) CPS had new structures to support standards-based education: the Chicago Academic Standards (CAS), Curriculum Framework Statements (CFS), and high school math and science Programs of Study with its aligned Chicago Academic Standards Examination (CASE). An instructional manual on the CAS and CFS went to 25,000 teachers, 120 schools received training to develop instructional modules aligned with the CAS and 423 schools attended workshops on standards. CSI also was credited with 1097 teachers enrolled in endorsement courses at 4 institutions between 1994 and 1998. Further,

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7 The district discontinued the use of ITBS after 2005 when the State Board of Education gave a statewide assessment in mathematics at every grade 3-8 as part of meeting NCLB requirements.
Another major accomplishment was the establishment of the Medill Professional Training Center and the creation of the Department of Instruction for Science, Mathematics, Health, and Technology (ISMHT) to continue the systemic reform efforts catalyzed by CSI (CUSP Annual Report of Progress, 2001).

Beginning September 2000, the Chicago Public Schools (CPS) district was awarded an $11.8 million Urban Systemic Program (CUSP) grant with the proposed goal “to increase significantly K-12 student achievement in mathematics and science by noticeably improving the level of performance of the current science and mathematics teachers.” To meet this goal, four initiatives were devised: “(1) the K-4 Specialization in Mathematics and Science; (2) the Grades 5-8 Mathematics and Science Endorsement Program; (3) the Grades 9-12 High School Science and Mathematics Certification Courses; and (4) the Professional Development Networks” (NSF Award Abstract, 2003).

CUSP reported that the Professional Development Networks supported by CUSP employed “Local School Teacher Facilitators” were the “most significant change agents in the school.” Each network of between 3 to 6 schools (25 CUSP Cohort 1 Schools) aimed to foster collaborative action research projects at the schools. The research projects were to improve student achievement in math and science (CUSP Annual Report of Progress, 2001).

In its first annual report to NSF, CUSP leaders explained how math and science activities in the district were located within several major programs in addition to CUSP: the Mathematics/Science Magnet Cluster Program and the Museum Partners Science Program. The CUSP report claimed that “all CUSP MSMCP, and MPSP activities are coordinated to support a common district agenda.” CUSP reported directly and indirectly impacting 29% of CPS schools, 30% of elementary teachers, and 13% of high school teachers during its first year (CUSP Annual Report of Progress, 2001).

MSP proposal to NSF (2001 - 2002)

In response to the National Science Foundation’s call for proposals for Math and Science Partnerships, a coalition of math and science educators, curriculum developers, and researchers submitted a bid to form a Chicago MSP. While the proposal “failed” and was not funded by NSF, the effort was influential on Chicago systemic math and science reform. [This story needs development. Among other things, the executive director of the proposed project was UIC’s Marty Gartzman—who shortly thereafter was appointed to serve as the first Chief Officer of Mathematics and Science at CPS.]

iii. The Pivotal Year of 2002

The year 2002 was a watershed year in Chicago for math and science systemic reform given major organizational and programmatic changes.

Changes to the Chicago Urban Systemic Program

In response to a mid-point review by National Science Foundation (NSF) in the spring of 2002 significant changes were made in the Chicago Urban Systemic Program. CUSP was revised to deliver 3 coordinated initiatives including: (1) sequences of university-based teacher professional development courses that could lead to either a K-5 specialization in mathematics and science or to a grades 6-8 mathematics and science endorsement; (2) a “Leadership Academy” to serve as professional development for the new staff of OMS; and (3) the planning and implementation of a new CPS Chicago Math and Science Initiative (CMSI).
The first initiative around university-based courses had its foundation in the beginning years of the CUSP. That initiative developed and has grown. See later sections in this paper for additional detail.

The later two initiatives of CUSP set the foundation for moving Chicago toward a more systemic reform effort which has grown and continued. This series of strategic activities described in Section 3 of this document all got their start in the planning “retreat” of the Leadership Academy and the launch of the CMSI.

CPS Office of Mathematics and Science

Catalyzed by the NSF review of the Chicago Urban Systemic Program, CPS changed its leadership structure for mathematics and science education. Prior to September 2002, the district supported mathematics and science through numerous projects with local schools and individual teachers independently pursuing various approaches and activities. No single CPS office coordinated mathematics and science education. To create a coherent plan for mathematics and science teaching and learning, in September 2002, CPS created a new department—The Office of Mathematics and Science (OMS)—staffed by about 30 individuals and led by a new cabinet-level Chief Officer Marty Gartzman. Gartzman also became the new Principal Investigator on the CUSP grant. The staff was comprised primarily of teachers and others who were to serve as instructional leaders of math and science with some clerical/business and evaluation staff also.

One of the first tasks of the OMS was to assess the district’s needs around math and science education. The need for the university-based courses leading to certification to teach math and science was a goal of the revised CUSP program and a clear need given the NCLB context and recent public concern about Chicago teacher quality. An early OMS study provided details on the extent to which there were gaps from too few certified teachers for various math and science courses in high schools and elementary schools. In another early attempt to assess district needs, OMS surveyed all schools and found 86 different elementary math and 43 different elementary science curricula texts in use. This diversity was not surprising given that under the auspices of site-based control in Chicago, the selection and purchase of curricular material was at the discretion of each schools via its teachers, principal and Local School Council. However, given this diversity, central district staff felt it was difficult to offer support or professional development around these curricular materials.

OMS was responsible for administering all facets of mathematics and science programming and infrastructure in the district, including:

- School year, after school, and summer school mathematics and science instructional programming and professional development
- District workforce development in mathematics and science
- Mathematics and science assessment development
- Evaluation, research, and data usage
- Laboratory safety, refurbishment, and new laboratory construction
- External partnerships
- Mathematics and science policies and budgeting

The centralizing of these responsibilities within a single district curriculum office was significant: it marked a move from total site-based, school-based management to a mixed model that recognized the coordination of mathematics and science centrally while operating in a local-control environment. In addition, this attempted to foster coherence in the district’s mathematics and science portfolio and
allow for “one-stop shopping” for individuals and groups interested or involved in mathematics and science issues in CPS schools. It also allowed the Board of Education and senior district leaders a potential locus for accountability for mathematics and science efforts at the district level.

In 2002, the new Chief Officer of Mathematics and Science Marty Gartzman (who retained the post through 2006), began to build the Office staff, first drawing on the various pre-existing departments and personnel involved in math and science work in the district. The OMS was built on a belief that this diverse group of people, from a variety of approaches and programs, could be drawn together to create and embrace a new vision of math and science instruction in Chicago as the core members of a new department. Because of the diversity of the work experiences and philosophies that these existing personnel/staff brought with them, the Chief Officer believed that intensive professional development was needed over an extended period of time to allow the staff to create the vision, rally around it, and learn to work together in a new way. Additionally, he believed that new staff would be hired as the department began to form and this professional development process would allow new staff to be integrated into the OMS. This intensive professional development process would mark the beginning of an ongoing training process for the staff. This process became to be known as the “Leadership Academy.”

Leadership Academy

The Leadership Academy engaged participants in an intensive professional development experience over a 3-month period (November 4, 2002 to January 31, 2003) for 56 meeting days with approximately 252 contact hours (about 4.5 hours a day). Approximately 30 participants regularly attended these afternoon workshops. Additionally, approximately 50% of these participants also engaged in co-teaching with a CPS teacher who was using a standards-based math curriculum. This occurred from November 18th until January 30th. For these participants, this was approximately an additional 125 contact hours (about 3.5 hours per day).

The Leadership Academy sought to develop coherence at the district level in several ways. First, it sought to create a cadre of district mathematics and science leaders who had a shared understanding of what high quality mathematics and science instruction in Chicago could look like. This understanding was to be based on the work during the Leadership Academy: careful review of research literature, discussions with practitioners and academic faculty from across the nation, and participation in classroom observations and co-teaching in classrooms. Second, it sought to develop a shared understanding of what high quality professional development should look like by modeling effective (Lieberman, 1995; Darling-Hammond & McLaughlin, 1995; National Research Council, 1999) professional development practices such as having participants reflect on their practice, apply new ideas, being actively involved, discuss challenging intellectual ideas, be engaged as sources of expertise, and receive regular feedback. A third goal was that the Leadership Academy sought to build a strong professional learning community among its participants who experienced the intensive professional development experiences together (Newmann & Associates, 1996; Elmore & Burney, 1997). Fourth, OMS planned to use the Academy time to collaboratively develop a plan to implement mathematics and science reform throughout the district. Finally, the planners of the Leadership Academy desired to model strong evaluation practices including the regular use of formative feedback.

The work accomplished at the Leadership Academy was central to the development of strategic activities central to Chicago systemic reform of math and science education. Additional detail on the role of the Leadership Academy in framing and initiating these activities can be found throughout this
paper, for example in the section on Curricular Materials that are Standards Based, there is a discussion about how the Leadership Academy was the site for reviewing and choosing specific curricular materials. In addition, several of the key leadership roles discussed in the section on Human Resource Support Strategies were defined during the Academy.

Chicago Math and Science Initiative

Out of the OMS Leadership Academy work came the plan for mathematics and science reform in Chicago and on February 18, 2003 the Chicago Mathematics and Science Initiative (CMSI) was officially launched at a press conference announcement by the two senior CPS officers--Arne Duncan, CPS Chief Executive Officer and Barbara Easton-Watkins, CPS Chief Education Officer; as well as Marty Gartzman, the CPS Chief Officer of Mathematics and Science. CMSI was CPS’ comprehensive approach to mathematics and science teaching and learning for the district. It involves a coherent alignment of district policies, adoption of high-quality research-based programs, more support for teachers (including increased high-quality staff development), and rigorous quantitative and qualitative evaluation by both internal and external professionals to be used in both formative and summative ways (see http://cmsi.cps.k12.il.us for more details).

The overriding vision for this work was to refocus the district’s efforts to enhance student engagement, learning, and achievement through:

- High-quality classroom instruction in mathematics and science using select, standards-based curricula
- Increased workforce capacity and competency in mathematics and science content knowledge and pedagogy through sustained, high-quality, content-specific professional development and external university partnerships
- Strengthened mathematics and science infrastructure (at school, instructional area [CPS subdistricts], and district levels) and coherent policy directives.

A logic model was later developed to help visualize this vision. (See the section in this paper on Logic Models).

At the Leadership Academy staff made several important decisions at the heart of the CMSI:

- The decision to ground school reform in standards-based curriculum materials and approaches informed by the research available.
- The decision to provide support for a small number of specific standards-based curricula in math and science to promote system coherence.
- The use of a phase-in model. In an attempt to eventually reach all schools, intensive efforts would begin with a smaller number of schools while broad support would be provided for all schools with a gradual extension of the initiative to all Chicago Public elementary schools. This model was intended to allow for early successes, to create buy in, and to allow program planners to work out “kinks” before scaling up.
- The use of an opt-in model. Schools in this site-based management district would volunteer to use the selected standards-based curricula.
- The use of supports for schools including money for buying curricular materials, professional development for teachers, and a school-based OMS-trained full-time staff member to assist teaching using the standards-based curricula. These were offered as part of an incentive based approach.
The use of formative and summative evaluation to inform the Initiative. At its inception, the CMSI was a comprehensive plan for both elementary and high schools. However, in 2006 as part of a districtwide restructuring, the Office of Math and Science became responsible only for elementary school programming and high school math and science education decisions moved to the Office of High School Programming (OHSP).

b. Organizations

Multiple organizations have been involved with Chicago’s reform of K-12 math and science education. Next we describe some of the characteristics of these formal organizations, specifically within the Chicago Public School district.8

i. CPS Organizational Structures

The third largest district in the country, CPS has a complicated and ever changing organizational and legal structure. To understand reform issues in this district there are a few key characteristics of the district that we review here: size, school building level local control, Area Instructional Offices and district instructional offices, and overarching district level reporting structures. Then we offer some organizational charts to provide a visual orientation to the district and its changes over time.

Chicago Public Schools is a massive unified district serving grades Pre-K through 12. From year to year the exact numbers of schools change as some schools close or become split into smaller schools. In 2002 there were 502 elementary and 87 high schools. By 2004 this had grown to 517 elementary and 94 high schools. In 2007, CPS had 483 elementary and 116 high schools of all types—regular neighborhood schools, selective enrollment magnet schools, charter schools, contract schools, performance schools, “small” schools, and other speciality school types. For simplicity throughout this paper, we approximate CPS’ size as 500 elementary and 100 high schools. These schools have a variety of different grade configurations, but the large majority of elementary schools are K-8 and high schools serve 9th-12th grade.

These schools employ approximately 20,000 teachers who are involved in math and science education: most of these are elementary school teachers and about 2,000 teach high school math and science. More than 400,000 students are enrolled in Chicago Public Schools. The students come from families that are primarily low income (~85%) with many families whose primary language is not English (~14%). ethnically, the composition of the CPS student population is approximately 47% African American, 40% Hispanic, 8% Caucasian, 3% Asian with the remainder Multi-racial or Native American.

The school building was a powerful unit of governance in Chicago Public Schools due to the 1988 School Reform Act. Decisions on budget, hiring and instructional design rested with the school’s principal and the Local School Council comprised of:

- 6 parent representatives
- 2 community representatives
- 2 teachers
- 1 principal

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8 We recognize that more informal social structures and networks of people in relationship have also been critical to the shape of this systemic effort. A description of these relationships is under development.
• 1 student representative (High School only)

School buildings were organized into geographically divided Areas that reported to the Area Instructional Offices created in 2001. Each of the 17 elementary school Areas employed a Math Science Coach who served the roughly 20 to 40 schools per Area. Each of the six high school Areas had a Math Coach and a Science Coach. Each Area reported to the CPS Chief Educational Officer.

Separate from the Area structure were district instructional offices that also reported to the Chief Educational Officer. The Office of Mathematics and Science was one of these offices along with an Office of Literacy, Office of Specialized Services, Office of Language and Culture, Office of Academic Enhancement, Office of Early Childhood, Office of Research, Evaluation, and Accountability.

District organizational charts offer some visual orientation to the ways that the district works. Contrasts of these charts across years can also help understand changes that may influence math and science education. We share the charts from 200X and 2007 below.

Figure 5  CPS Organization Chart, 200X

[Forthcoming Pre-2007 Chart to be inserted]
Figure 6 CPS Organization Chart 2007 [Forthcoming … improve print quality]

[Forthcoming: Description of CPS organizational structure ]
Figure 7 CPS Office of Math and Science Organization Chart, Fall 2005  [Forthcoming—improve print quality]
The boxes shaded above (Citywide Mathematics and Science Specialists, K-8 Math/Science Coaches, HS Mathematics Coaches, HS Science Coaches) represent positions that span from the Office of Math and Science into other branches of the CPS organizational structure. The figure below is a representation of the elementary school personnel infrastructure with a simplified OMS organizational chart above in relationship to the Area Instructional Offices.

[Description of organizational structures with responsibilities for high school math and science issues are forthcoming]

Figure 8 CPS district math and science elementary school administrators and instructional support personnel, Fall 2005

A parallel figure for high school math and science efforts in 2005 would be more simple because reporting to the OMS Chief Officer was a Manager of High School Team and just two High School Math and Science Facilitators. They worked with 12 Area Math and Science Coaches in the service of ~100 high schools.
c. Key Programs and Policies

The scale of math and science efforts underway in Chicago is vast. The most common way that those involved in these efforts talk about them is in terms of specific programs or policies. Programs and policies are also the more common unit of analysis for those studying these efforts. Next we describe some of the key elementary and high school programs and policies. When available, for each we list the evaluation reports that highlight the processes and outcomes of these programs and policies.

This section focuses on the information about these programs/policies rather than a discussion of the reasons for them or how they were structured to meet strategic district needs/goals. While we review programs one-by-one, we recognize that these are interactive and not always easy to distinguish in practice. Often teachers and administrators participating within these programs may not even realize the names of the program(s) impacting their schools. In addition, these programs have grown out of each other to meet the evolving needs of the district. These deeper design issues and the dynamics of implementation will be reviewed, not in this section but in Section 3.

i. K-8 Elementary Schools

- Time on math and science policy (2003-2008)
- CMSI-supported curricula (2003-2008)
- CMSI curricula-specific professional development workshops (2003-2008)
- Professional development leaders (2003 – 2008)
- CMSI incentive program with Intensive Support Schools (2003-2005)
- CMSI policy for schools on probation (2004-2008)
- OMS and Area math and science instructional leader positions (2003-2008)
- University-based math and science courses with tuition policy for elementary teachers (2000-2008)
- Teachers gaining state endorsements in math and science (2000-2008)
- Endorsement and staffing policy (2008)
- University master’s degree programs for teachers in math and science (2004 – 2008)
- Grade 8 Algebra Initiative program and policies (2003-2008)
- STEP UP to High School summer program (2003 – 2008)
- Cluster 4 Middle Grades Project (2006-2008)

Time on math and science policy (2003-2008)

One of the first policies to be set after the creation of the new Office of Math and Science was a CPS policy that schools must provide 60 minutes a day of math instruction and 120 minutes a week of science instruction to all CPS elementary school students. In comparison, in 2003 the district had a relatively new policy that all elementary schools teach two hours each day of reading for all students. Based on the results of collective bargaining, the length of the school day has increased slightly over this time period in elementary schools from 5.5 hours of instruction in 2003 to 5.75 hours of instruction since the 2004-05 school year. High school instructional time is essentially the same as
for elementary schools (a few minutes more per day). The school calendar in Chicago includes 178 instructional days/school year. [See related evaluation reports].

CMSI-supported curricula (2003-2008)
Beginning in 2003, the CPS Office of Math and Science began building its programming around a small number of standards-based curricula that they felt teachers could use to offer high quality teaching and learning in their classrooms. An inventory of elementary school math and science curriculum in use in Chicago Public Schools conducted by OMS staff during planning stages revealed 86 different math and 43 different science text books. During the Leadership Academy, OMS identified 4 standards-based mathematics curricula and a single scope and sequence for science using 4 standards-based science curricula for the elementary school level. For primary level math the district staff chose Everyday Math and Math Trailblazers. For middle grade math, Connected Math and Math Thematics were chosen. The elementary science curricula were chosen to follow a “Scope and Sequence” of topics outlined by OMS. These science curricula units were drawn from FOSS (Full Option Science System), SEPUP (Science Education for Public Understanding Program), IES (Investigating Earth Systems), and STC (Science and Technology for Children). All of these programs were developed with the support of the National Science Foundation.

At the initiation of their focus on these curricula, OMS offered schools opportunities to learn about these materials in order to make decisions on what the school would choose to purchase and use. All schools were invited and encouraged to attend Instructional Materials Showcases and Technical Support Workshops. At these gatherings, publishers and authors of CMSI selected curricular materials provided information and demonstrations of their products. The first of these sessions was offered in winter 2003 to inform schools about the new CMSI plans and to provide an opportunity for these schools to compare these curricula side-by-side. These sessions were then offered again in winter 2004 to educate additional schools about the curricula. [See related evaluation reports].

CMSI curricula-specific professional development workshops (2003-2008)
Having streamlined the curricula to 5 standards-based elementary math and science curricula (4 math and 1 science scope and sequence which included materials from 4 different publishers), the district was in a better position from which to provide professional development of teachers. Building on the research about professional development, the district planned an ambitious two year program of curricular support for all teachers starting to use the curricula. The professional development workshops were offered in a grade-specific and curriculum-specific manner. In their first year teachers enrolled in New Users’ professional development which started with an intensive week-long summer session and was followed by monthly sessions throughout the year. Then in their second year of using the curricula, the teachers enrolled in Experienced Users’ professional development which followed a similar structure. [See related evaluation reports].

Professional development leaders (2003-2008)
From the start of the CMSI efforts, the issue of who would lead the large number of professional development workshops was a concern. In 2003-2004 through 2005-2006, the University of Chicago sought and received Illinois Board of Higher Education (IBHE) grants to train experienced teachers who could then lead workshops around the Everyday Math K-6 curricula that the University supported for the district. In 2004-2005 through 2005-2006, the University of Illinois at Chicago got
comparable grants from IBHE to prepare leaders of the district CMSI Math Trailblazers and Connected Mathematics curricula professional development workshops.

In 2005 the OMS along with some of its university partners initiated the Professional Development Leadership (PDL) program, which was designed to train and support a pool of qualified teacher leaders to provide high-quality professional development at the district level, for designated, CMSI-supported mathematics and science instructional materials. Prior to the development of PDLs, much of the content based training had been done under the aegis of consultants from the curriculum developers and providers, and also from local university partners. The development of PDLs represented a significant step in institutionalizing professional development within CPS, and also in building capacity for systemic change. Beginning in 2006 it has also become a goal of the Program to coordinate and standardize the recruitment, training, certification, role expectations, and ongoing supports for Math and Science professional development leaders (PDLs).

The program operates in the following way: OMS facilitators or specialists, faculty at local universities, Area coaches, or school principals nominate a group of effective math and science teachers who are experienced curriculum users. These teachers are recruited to participate in a 3-day Professional Development Leadership Academy—either in math or in science. Participants (PDL “trainees”) receive training in curricular philosophy, content and pedagogical knowledge, and adult learning. They work in teams to prepare a “mini” professional development session and receive feedback by experienced PDLs and/or OMS facilitators. In the past both Math and Science Academies’ workshops were facilitated by OMS curricular facilitators and/or PDLs. In 2007-08, the Science Academy workshops were led by representatives from the curriculum publishers/vendors.

By the end of the 3-day Academy, all participating PDLs (which includes “trainees”, “new” PDLs and “experienced” PDLs) are supposed to sign up to either observe (trainees), co-present (new PDLs), or lead (experienced PDLs) a summer professional development session. PDLs are also expected to lead professional development during the school year. How that is organized is different for Math and Science, and varies within Math by curriculum. Upon meeting formal criteria and numbers of hours set out in the PDL “Blueprints,” PDLs receive their certification.

PDLs’ formal role is leading district-wide professional development. However, it is assumed that certified PDLs are qualified to lead Area professional development. Heading into the 2008-09 program year, a program is being developed in which PDLs would also be expected to lead professional development for the Area. While there is an informal expectation that PDLs be “teacher leaders” in their schools, there are no formal expectations regarding their school roles associated with the position of PDL. [See related evaluation reports].

CMSI incentive program with Intensive Support Schools (2003-2005)

Around the selected CMSI-supported curricula the OMS staff constructed a phase-in model of school implementation that would allow them to gradually support the introduction of standards-based materials into an increasing number of schools and classrooms. The decision of what instructional materials a CPS school used rested legally by Illinois law with each individual school principal and Local School Council (LSC)—a group comprised of teachers, parents, and community representatives. The CMSI elementary plan was based on providing incentives to schools to choose the designated curricula. In this model, all elementary schools in the district (~500) were invited to apply to become “Intensive Support” schools.
Intensive Support schools were chosen through a selection process that attracted 207 applicant schools in spring 2003. Based on reviews of these applications and site visits to 177 schools, 81 schools were chosen as Intensive Support schools, 22 in Science and 59 in Math. Schools were evaluated on various criteria focused on discerning if they had strong enough foundations to engage in reform activities. Reviewers looked at schools’ commitment to the new program, capacity for collaborating within the school and with others and leadership.

Intensive Support schools were then supported with the expectation that all of their teachers would implement the chosen standards-based math or science curriculum within two years. In the first year a group of “First Wave” teachers were trained, one from each grade level. In the second year, all remaining teachers in the school were to be trained to use the materials.

Two dozen schools were selected from the pool of applicants as “Readiness Schools.” These schools were judged to be schools that OMS would like to support intensively but which needed additional assistance in bolstering the commitment and “readiness” of school administrators and teachers. Teachers from these schools attended workshops during 2003-2004 as part of readiness training. CPS partnered with The Teachers’ Academy for Math and Science to provide these workshops on constructivist pedagogy in order to help teachers begin to understand the shift in teaching and learning that the OMS was promoting within the CMSI. In addition, these year long professional development sessions provided teachers with the opportunity to experiment in the use of the four CMSI-supported mathematics curricula in order to create buy-in to their choosing and eventual use of two of these curricula at their schools (one at primary and one at middle grades level).

The Chicago Public elementary schools that were not Intensive Support or Readiness were designated “Broad Support Schools.” These schools were to be supported in their move toward standards-based approaches by various district support structures. Teacher workshops and training were also made available to teachers from these schools. For example, a number of Area Mathematics and Science Coaches created professional development sessions geared to school-level ISAT data to instruct and support the teachers in these schools on what they could learn and improve by looking closely at their own data.

Intensive Support schools were given funds, professional development and mentoring support. Intensive Support schools were each given $1,000/classroom per grade level (i.e., allocation dependent on the size of the school with the average K-8 school receiving $10,000) to help defray the cost of purchasing CMSI supported curriculum materials in 2003-2004. In total OMS provided approximately $750,000 for mathematics and science material purchases at schools. In addition, OMS made a two-year commitment to provide them with a funded full-time (released from teaching duties) school-based math or science curriculum Specialist to assist with implementation. In the summer of 2003, seventy-seven Specialists received a two-week training session. Ongoing monthly professional development training in leadership and specific standards-based curricula were also provided to Specialists. Those designated First Wave teachers, approximately one teacher per grade level, were also provided with professional development training. First Wave teachers were offered curriculum-specific training in the summer of 2003. Three to five day workshops were offered in the four math curricula and a combined science workshop was offered. Throughout the 2003-2004 school year, First Wave teachers were offered an additional one day per month of professional development. Additionally, principals at these schools were invited to a year-long series of 5 two-hour meetings with senior OMS staff. Furthermore, OMS Facilitators, who were assigned between 5 and 11 Intensive Support schools, provided outside expertise to improve implementation in these schools.
through visiting schools, mentoring the Specialist, providing professional development, and working with teachers

[Description of how local discretionary funds handled under site based management forthcoming].

[See related evaluation reports]

CMSI policy for schools on probation (2004-2008)

The Chicago Math and Science Initiative began in 2003-2004 as a voluntary opt-in program. Due to the influence of No Child Left Behind (NCLB) policies, in spring 2004 district leaders made policy and program decisions that shifted the CMSI to a mandatory program for some schools. As a result of NCLB, CPS changed the benchmark schools needed to meet in order to be designated as making Adequate Yearly Progress (AYP). In 2004, schools were placed on probation by the district if they did not have at least 40% of their students scoring at or above national norms for reading on the standardized tests. This was an increase from the level of just 20% at or above average used from 1998 to 2003. As a result of the new benchmark, 166 schools (around 40% of the elementary schools) were placed on probation.

Initially, district policies for schools on probation set up guidelines for how school-level budgets should be used, and then established more centralized control of purchasing decisions. Probation schools were directed to adopt the CMSI-specified math and science curricula when purchasing new texts. These schools could then be supported by district professional development in the curricula and other OMS and Area resources focused on the use of these materials. Based on OMS professional development attendance records, teachers from at least 95 schools on probation attended workshops on the CMSI-supported curricula in summer 2004 and the 2004-05 school year. [See related evaluation reports].

OMS and Area math and science instructional leader positions (2003-2008)

In the summer 2003, OMS created a system of instructional leadership positions, hired for these positions, and began training and managing the professionals in these positions. The CMSI built up the human mathematics and science district infrastructure to include 116 district Facilitators, Area (i.e., sub-district) Coaches, and School-based Specialists (see previous paragraph on Intensive Support schools). These instructional leaders were developed and deployed to schools to support their mathematics and science instructional programs. Since 2006, OMS moved away from funding salaries for Specialists who worked with just one school and instead adopted a model for Citywide Specialists who were employed by OMS and served four schools each. Through 2008, OMS continued offering various professional development workshops for various math and science leaders.

All schools including the Intensive Support schools were provided support from the Area Math/Science Coaches. These Coaches were based in each of the 18 CPS Instructional Areas—geographic sub-district structures with a mission to focus on supporting the instructional practices of their schools. Through an intensive selection process, 18 elementary Coaches were hired to support both math and science instruction in their Areas. Most elementary Coaches were hired in consultation with OMS and most participated in the three weeks of OMS sponsored professional development training in July 2003 that was designed to assist them in defining and enacting their role as full-time professional developers. However the CPS structure required Coaches to report to their Area Instructional Officer (i.e., the chief officers in charge of the Areas) rather than to OMS. Due to the
demands of their instructional Area, many Coaches did not attend the curriculum specific workshops offered in August 2003, even though OMS encouraged their attendance. During the first half of the 2003-2004 school year, OMS organized weekly meetings and professional development workshops for these Coaches. By the spring 2004 this decreased to bimonthly meetings/professional development sessions and currently, Area Coaches are almost exclusively under the purview of their respective Areas. While OMS funds paid Area Math Science Coaches from 2003 through 2005, they have since been funded by their Areas.

Facilitators were hired as core staff at OMS and as curriculum experts. They were involved in the Leadership Academy in which the CMSI was planned. These individuals supported the curricula in which they specialized since 2003 by working directly with teachers, coaches, and specialists (first in-school Specialists, and Citywide Specialists). Staff turnover led to fluidity of personnel in these and other positions—for example, by 2008 some of the Facilitator positions were held by individuals who started in 2003 as Specialists. [See related evaluation reports].

University-based math and science courses and tuition policy for elementary teachers (2000-2008)

Central to systemic efforts to improve math and science education in Chicago Public Schools was a push to enroll practicing teachers in specially designed university math and science courses where they could strengthen their content knowledge in ways useful for their teaching. The development of these courses began in 2000 funded by the NSF Chicago Urban Systemic Program grant to CPS and a group of university faculty from math and science departments and education.

Building on the newly designed Chicago Urban Systemic Program university courses in fall 2003, the district and university partners launched a major new strategy. Courses previously piloted plus new courses were arranged into coherent sequences for programs. These programs were created by universities at the invitation of, and, then, approval by the district’s leaders. The district framed the need for courses in terms of the No Child Left Behind Act which required that teachers be “Highly Qualified” in their areas of teaching. To meet NCLB, more CPS teachers needed to gain State of Illinois endorsements to teach middle grades math and/or science.

The approved programs were described by the district as providing “a solid combination of math or science content and appropriate pedagogy... with individual courses link[ing] content and pedagogy and connect[ing] the substance of the courses to the teachers’ own classrooms” (District document, 2003). Documents further elaborated on design principles of these courses and programs, in terms of

- Content: Teachers learn content at and above the level of the learners they teach.
- Pedagogy: Teachers learn, practice and reflect upon pedagogical approaches represented in current math and science standards.
- Classroom Connections: The tasks of the professional development require teachers to practice curriculum analysis, implementation, and adaptations in their own classrooms.
- Student Work: Teachers practice analyzing and assessing student work samples.

Five different types of programs were created so that elementary school (grades K – 8) teachers completing them would obtain credentials including: District Grades K-5 Math Specialization, District Grades K-5 Science Specialization, State Middle Grades Math Endorsement, State Middle Grades Science Endorsement, and District Grade 8 Algebra Certification. Each program sequence...
has a different number of classes necessary for completion. The minimum number of classes in any sequence is for the Grade 8 Algebra Certification, where teachers take two semester classes then sit for an exam. If they pass, the teacher receives a district credential which allows him/her to teach algebra in 8th grade. The middle grades sequences were designed so that a teacher who took all the classes in the sequence would meet the content requirements for their math/science endorsement.

Programs with district approval were then able to enroll district teachers who received tuition subsidies from the district. As a stipulation of CPS-provided tuition support for taking these courses, teachers were asked to sign a “participation contract” that they must pass the course taken and continue to teach at CPS. If they did not, they would be required to reimburse the district. However, mechanisms for enforcing this contract were not used. In addition, some teachers received their tuition support in whole or part from external sources and were not required to sign a participation contract.

Table 4 shows the number of university classes offered per academic year broken down by the type of program\textsuperscript{10} that course falls under. Clearly, Middle Grades Math Endorsement courses are the majority of the offerings. The number of enrollments steadily increased in each academic year since the inception of the university courses partnership as seen in Table 5 below. Table 5 shows the number of enrollments per academic year and Table 6 the number of unique teachers taking courses (defined in this document as summer semester/quarter to the following spring semester/quarter. When one looks at the annual enrollments in comparison to number of courses the average class size holds steady at about 16.5 teachers per course with the exception of a larger average size of over 19 for the 2002-2003 courses. Note that teachers may enroll in several different classes in a given academic year. Between 2001 and spring 2005 more than half of the teachers took only 2 courses. However, hundreds of teachers have taken 3 or more courses. Around 40% of the teachers took between 3 and 9 courses.

Due to administrative capacity issues at CPS the data for 2005 - 2008 was not available.

[See related evaluation reports].

\textsuperscript{10} Program was designated to each class based on either notations by the university on the roster, or by checking the course offerings booklet to determine what program the course was in. In some cases the program was not clear. Most programs are aimed at elementary schools but there is a small program in high school math that is included in these figures. Disaggregated data on teachers in elementary vs. high school content knowledge courses should be studied in the future.
Table 4. Number of district supported classes offered per academic year by program type

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>K-5 Math Specialization</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>--</td>
</tr>
<tr>
<td>K-5 Science Specialization</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td></td>
</tr>
<tr>
<td>Middle Grades Math Endorsement</td>
<td>27</td>
<td>30</td>
<td>50</td>
<td>39</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td></td>
</tr>
<tr>
<td>Middle Grades Science Endorsement</td>
<td>0</td>
<td>6</td>
<td>2</td>
<td>15</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td></td>
</tr>
<tr>
<td>Grade 8 Algebra Certification</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>6</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>18</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>41</td>
<td>64</td>
<td>98</td>
<td></td>
<td></td>
<td></td>
<td>236</td>
</tr>
</tbody>
</table>

Table 5. Total enrollments by academic year

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Number of enrollments</th>
<th>% of total enrollments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-2005 (Summer 2004 – Spring 2005)</td>
<td>1624</td>
<td>39.6</td>
</tr>
<tr>
<td>2006-2007 (Summer 2006 – Spring 2007)</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>2007-2008 (Summer 2007 – Spring 2008)</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Total</td>
<td>4100</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 6. Number of teachers by academic year

<table>
<thead>
<tr>
<th>Academic Year</th>
<th># of new teachers enrolling</th>
<th>Number of unique teachers participating</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002-2003 (Summer 2002 – Spring 2003)</td>
<td>245</td>
<td>420</td>
</tr>
<tr>
<td>2004-2005 (Summer 2004 – Spring 2005)</td>
<td>341</td>
<td>590</td>
</tr>
<tr>
<td>2006-2007 (Summer 2006 – Spring 2007)</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>2007-2008 (Summer 2007 – Spring 2008)</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Total teachers</td>
<td>1248</td>
<td></td>
</tr>
</tbody>
</table>

11 The Grade 8 Algebra Certification is specifically targeted to help teachers get a district credential to enable them to teach 8th grade algebra.
12 There were four classes to which we were unable to assign a program description. We are working with the program coordinators to resolve this.
13 The number of enrollments refers to the numbers of classes taken. Each teacher can take multiple classes and therefore many teachers account for more than one enrollment.
14 These teachers are only unique within the year not across years, as many teachers participate in classes across multiple academic years.

January 26, 2009  WORKING DRAFT  NOT FOR CIRCULATION OR CITATION  swenzel@luc.edu
Teachers gaining state endorsements in math and science (2000-2008)

Under 2008 policies, in order to obtain a middle grade endorsement in math or science in the State of Illinois a teacher must have:

- 18 semester hours of credit in content area courses, and
- 3 semester hours of coursework in middle school philosophy, curriculum and instructional methods for designing and teaching developmentally appropriate programs in the middle grades, including content area reading instruction; and
- 3 semester hours of coursework in educational psychology focusing on the developmental characteristics of early adolescents and the role of the middle grade teacher in assessment, coordination and referral of students to health and social services.

Between 2003 and 2006, 259 CPS teachers gained mathematics endorsements for middle grades teaching. Of these, 62% (160) were participating in the CMSI university-based programs. Likewise 202 CPS teachers gained middle grades science endorsements with 42% (85) of these participating in the CMSI university-based programs. Overall, the percentage of teacher enrollments in these programs that have obtained endorsements has been very small. Between 2001 and 2006, just 3% of enrollments resulted in middle grades math endorsement and 1.5% in middle grades science endorsements (CPS Department of Program Evaluation, January 2007).

In April 2008 across CPS elementary schools, on average 7% of teachers had math endorsements and/or majors and 9% had science endorsements and/or majors. On average, there was one endorsed math teacher per 289 students and one endorsed science teacher per 223 students. Looking at distribution across the geographically located Instructional Areas of the district, in math the percentage of endorsed teachers ranged from 5% to 9% and in science ranged from 7% to 12%. [See related evaluation reports].

Endorsement and staffing policy (2008)

On October 22, 2008, the Chicago Board of Education adopted a new Middle Grades Specialization Policy. Its purpose was to require that students in grades 6, 7, 8 receive instruction in language arts, mathematics, science and social studies from teachers recognized by the Illinois State Board of Education as specialists in those content areas. That impact of this significant policy will be watched carefully by those engaged in Chicago’s systemic reform of math and science. [See related evaluation reports].

University master’s degree programs for teachers in math and science (2004 – 2008)

[Forthcoming description of increase of master’s degrees for teachers in math and science at universities active in the CMSI university-based endorsement programs.] [See related evaluation reports].

Math benchmark assessment program (2004-2008)

In collaboration with Prof. James Pellegrino’s group at the University of Illinois at Chicago, the OMS designed and implemented a standards-based assessment system in mathematics. In 2004-2005, the district collected and categorized over 1,000 mathematics items in grades 3-8 according to the State of Illinois’ Learning Standards. A pilot test was then conducted to establish the
psychometric properties of these items for CPS students. Using a matrix block design similar to that used for the National Assessment of Educational Progress (NAEP), the pilot test involved approximately 500 items in 24 schools, involving approximately 250 classrooms and 620 students. From the results of this pilot test, 3 benchmark assessments were constructed for field testing in 2005-06. This field testing, which involved further testing of the items, testing of the extended response scoring procedures, and examining alternative models for district-wide administration, was completed in 2005-06. It involved over 10,000 students in grades 3-8. It utilized a unique approach to assessment involving teachers in the scoring process of extended response items, sharing of multiple choice distractor analyses, and incorporated professional development on assessment literacy directly into the process. The district expanded this work to all elementary schools in the 2006-07 school year. [See related evaluation reports].

Grade 8 Algebra Initiative program and policies (2003 – 2008)

In 2004, 7% of CPS 9th grade students had taken algebra prior to entering high schools. This was much less than the 34% rate nationally. Getting more grade 8 students enrolled and successful in taking algebra was a priority of OMS since it began in 2002. OMS in partnership with other departments, teachers and university faculty together designed and implemented a three pronged approach to algebra instruction for students at the transition point of grade 8 elementary school into grade 9 high school. In high school, the research showed that Algebra I was a key foundation for success—if students failed this course they had a strong likelihood of failing other courses; it provided key knowledge that would be used in other math and science courses; and it was necessary to take algebra early if students hoped to prepare for college with AP and college preparation math courses. Here we describe the grade 8 algebra programs and policies and the STEP-UP to High School summer program for algebra and then, when we turn to describing high school programs, we consider the Two Period Algebra program for grade 9.

Since 2003, mathematics faculty from UIC, DePaul and the University of Chicago created and taught a year-long series of university algebra courses with an assessment exam for teachers and an exam for grade 8 students who take Algebra I. Teachers who met the requirements of these courses and passed the test were eligible to teach algebra to students in grade 8 who met criteria set by OMS. Upon completion of a course taught by a qualified teacher, students were eligible to take an exam that could earn them high school credit for the 8th grade algebra class.

In order to receive a credential to teach 8th grade algebra in this district teachers must:

- Successfully complete a one-year course sequence that focuses on algebra content and the teaching of algebra
- Pass an end-of-program qualifying examination that was developed jointly by the faculty from these three universities; and
- Complete the requirements for the formal middle grades mathematics endorsement.

The courses were developed by the university faculty who taught them. At two universities, the Grade 8 Algebra Certification program consisted of three quarters, while at the third it consisted of two semesters. The Office of Math and Science managed the acceptance of teachers into the program and funded their tuition remissions for the program in the same way as they did for teachers in other math and science content courses (as described in the previous section on K-8 math and science university programs).
However the model for the grade 8 Algebra Initiative was more complex given that many of the policies influencing it came not from OMS but from the Office of High School Programming (OHSP). OHSP interpreted which teachers met State requirements allowing them to teach Algebra I (a high school course) to grade 8 students. To offer a high school Algebra I course, teachers must possess a type 09 high school mathematics certificate OR teachers must have a type 03 certificate, a middle-grade mathematics endorsement, and the "CPS algebra qualification." OMS continued to fully support tuition cost for teachers participating in the Algebra Initiative.

OHSP also determined the policy for how students were given credit or placement if they successfully passed the Citywide Algebra Exit Exam given in May to both middle grade and high school students who took Algebra I. Interpretation of State of Illinois policy on high school credits was at the heart of numerous meeting among OMS and OHSP math staff during 2007-08 and earlier. In need of answering was the question of whether grade 8 students taking Algebra I from a qualified teacher would receive acknowledgement of success if they passed the student Citywide Algebra Exit Exam. Would they receive credit for a high school course on their transcript or rather receive placement into a higher level math course in high school?

The Algebra Initiative has been sustained over several years in Chicago with its influence progressing as the teachers enrolled in the courses then passing (or not) the CPS Algebra Qualification Test and then some taught grade 8 algebra. As of 2007-08, schools also had to receive approval from OHSP to offer grade 8 algebra. Students who took Algebra I in grade 8 were eligible to take the spring Citywide Algebra Exit Exam and if they passed they received credit or placement.

Table 7: Algebra Initiative Outcomes, 2002-2009

<table>
<thead>
<tr>
<th>Year Summer to</th>
<th>Teachers passing CPS Algebra-Qualification Test (Summer)</th>
<th>CPS Algebra Qualified Teachers total</th>
<th>Schools approved by OHSP to offer algebra to middle grade students</th>
<th>Students taking approved grade 8 algebra (estimated)</th>
<th>Students (from # of schools) taking Citywide Algebra Exit Exam (May)</th>
<th>Students passing Citywide Algebra Exit Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer 2002-Spring 2003</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Summer 2003-Spring 2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer 2004-Spring 2005</td>
<td>43 passes of 69 tested (62% pass)</td>
<td>43</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer 2005-Spring 2006</td>
<td>36 passes of 48 tested (75% pass)</td>
<td>79</td>
<td>na – no approval process yet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer 2006-Spring 2007</td>
<td>24 passes of 31 tested (77% pass)</td>
<td>103</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer 2007-Spring 2008</td>
<td>58 passes of 98 tested (59% pass)</td>
<td>161</td>
<td>81</td>
<td>2572</td>
<td>2051 (80)</td>
<td>746 or 36%</td>
</tr>
<tr>
<td>Summer 2008-Spring 2009</td>
<td>120 took test</td>
<td>245</td>
<td>170 applied</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Leaders of the AI were working to change the timeline for teacher testing. The system that had been in place tested most teachers in the summer. This could be problematic because schools needed to plan their course offerings for the following year in the spring. If their offering of algebra for middle grades student depended on a teacher passing the summer test—this set the school up for uncertainty and the teacher up for great pressure on how they perform on the test day. AI leaders in 2008 discussed how a teacher test in December would work much better for the district.

The district also worked to better promote and communicate about the process (new in 2007-08) for approving grade 8 algebra courses. The advice was on the CPS website for schools considering offering grade 8 algebra or, officially, high school Algebra I for middle grade students. See http://www.cmsi.cps.k12.il.us/ViewProgramDetails.aspx?pid=777.

[See related evaluation reports].

STEP UP to High School summer program (2003 – 2008)

The Step Up to High School program was designed to assist students in their transition from middle grades (8th grade) to high school (9th grade). The program, which targeted students who were considered to be “at-risk” with respect to their ISAT percentiles, was a four-week summer session that focused on courses in mathematics and literacy. In addition, Step Up students received programming aimed at helping them with the socio-emotional components of their transition to high school, met adults and peers with whom they would interact in the forthcoming year, and became familiar with their new high school building. The program’s math courses stressed skills that formed a solid foundation for future work in algebra, such as proportional reasoning, symbolic representations, variable manipulation, and graphing. Schools were encouraged to select their most highly qualified teachers for the summer program. Over the years since the program’s inception (summer of 2003) participation in Step Up was associated with higher performance in both algebra (9th grade) and geometry (10th grade) among students who completed the program relative to qualifying students who did not complete the program (See http://research.cps.k12.il.us/cps/accountweb/Evaluation/View_Evaluation_Reports/View_Only_Internal_Evaluations/Annotated_Bibliography/ ). [See related evaluation reports].

Cluster 4 Middle Grades Project (2006 – 2008)

Beginning in 2006-2007, OMS led the CPS Cluster 4 Middle Grades Project (C4MGP), funded by the Chicago Community Trust and the James McDougal Foundation. Through this project, 24 schools in 2006-2007 and 33 schools (23 from the 2006-2007 cohort and 10 new ones) in 2007-2008 worked to improve how they prepared middle grades students for high school by supporting their teachers in gaining content knowledge and endorsements in math and science, in departmentalizing classes, in using CMSI-supported curricula, in offering grade 8 algebra and in better understanding the needs of adolescent students particularly in terms of study skills needed for high school. This project involved multiple university partners: the UIC math program leading toward middle grades math endorsement, the Loyola middle grades science program leading toward state endorsement, and consulting faculty from National Louis University and from Northwestern University who worked with principals and other district leaders. [See related evaluation reports].

ii. High Schools

- Curricula selection and course planning process (2003-2008)
- Double Period Algebra (2003-2008)
• OMS, OHSP, and Area high school math and science instructional leaders (2003-2008)
• University-based math and science courses and tuition for high school teachers (2004-2008)
• IDS/HST assessment data (2006-2008)

Math and science education in high schools was coordinated by the CPS Office of Math and Science from 2002 through 2006. At that point, the district moved these functions into the Office of High School Programs. Many of the CPS staff designing the elementary math and science strategies also designed those for high schools. Several OMS staff moved to the OHSP during and after 2006. Compared to the significant attention paid to elementary school activities, both internal and external evaluation of the high school math and science activities have been minimal. Still there were a number of efforts around high school in the early days of OMS that were documented by external evaluators.

**Curricula selection and course planning process (2003-2008)**

In 2003-2004 through 2005-2006, the Office of Math and Science staff worked with high school math and science departments to facilitate professional learning and decision-making communities within and across math and science departments in all schools. With the intention to create a strategic, data-driven process, these communities worked together to develop coherent programs of study and to adopt high quality curricula within these programs of study. The process included both the city-wide selection of high school curricula and an in-school planning process that collected and shared locally developed assessments. Evaluation did not document these processes beyond providing some sense of the OMS staff’s enthusiasm for these processes.

In spring 2004, OMS announced the curricular materials they recommended be used for core high school math and science courses. These curricula were selected through a process of review committees from each of six CPS Areas and other citywide committees and review opportunities for teachers. For example, for Algebra, they recommended Cognitive Algebra Tutor (Carnegie Learning), Discovering Algebra (Key Curriculum), UCSMP (Pearson-Prentice Hall), and Algebra 1-Illinois Edition with Agile Mind supplement (Glencoe). Materials for Biology recommended were Biology The Dynamics of Life (Glencoe), BSCS A Human Approach (Kendall/Hunt), BSCS An Ecological Approach (Kendall/Hunt), and Biology Exploring Life (Pearson-Prentice). OMS provided incentives for schools selecting these curricula by offering funds to supplement the purchase and professional development for teachers using it.

For the 2004-2005 school year teachers, department chairs and principals in probation and demonstration schools were expected to establish a concrete planning process for each required course. The support of this process came jointly from curriculum offices like OMS and from the six CPS Area High School Instructional Offices. [See related evaluation reports].

**Double Period Algebra (2003-2008)**

In 2003-2004, OMS began working with district high schools and requiring a subset of students to enroll in a “double period” of algebra—90 minutes or two periods as compared to a regular 45 minute period. The targeted subset of students was entering 9th grade with 8th grade math standardized test math scores placing them less than the 50th percentile of the population. These students were believed likely to benefit from additional time spent in algebra. No specific curriculum was required.
for double period algebra but OMS intended that schools use two back-to-back periods taught by the same teacher and attended by the same students.

In 2004-2005, OMS more clearly specified the content of the double period algebra course. OMS staff designated two sets of curricular materials as required for the 45 minute Algebra Problem Solving (APS) course. This was to accompany the regular 45 minute Algebra courses. MathScape or IMP (Integrated Mathematics Program) were the chosen curricula. Summer workshops for teachers were offered by OMS as were professional development sessions during the school year—including a full-day session for all APS teachers in IMP or MathScape in early December 2004.

In 2005-2006 the Two-Period Algebra (TPA) class was specified for use by all CPS high schools based in part on the lessons learned from the previous incarnation of the courses. The new component was that the full 90 minute course would have a specified curriculum that was based on a TPA Curriculum Guide and supported by professional development. [See related evaluation reports].

High School Transformation (2006-2008)

In 2005 in partnership with the Bill and Melinda Gates Foundation, CPS announced a program to intensively support underperforming high schools with new curricular materials, teacher professional development, instructional coaching, improved assessment systems, etc. According to its original request for proposals (RFP), the High School Transformation (HST) project was designed through a six-month strategic development process that gathered input from hundreds of key stakeholders from a diverse set of Chicago schools and communities: High school students and their families; young adults in the community who had left CPS high schools before graduating; and teachers, principals and district leaders with years – and decades – of experience serving Chicago students. The leaders of the HST also worked with dozens of local and national education research and reform experts, as well as prominent successful leaders of other large urban districts. The strategy set they arrived at includes several components that they believed would change the equation for the way the district supports teachers and principals. It also included infrastructure changes that could serve families more equitably and establish better accountability and capacity building roles for the district.

Central to the RFP was the request for building holistic “Instructional Development Systems” (IDSs) focused on specific curricula facilitated by high quality professional development and expert, low-ratio coaching. HST targeted three subject areas: reading/language arts, mathematics and science. For each of these subject areas, CPS proposed three different “approaches” that was, 3 different sets of curricular materials. This meant that CPS asked for 9 different IDSs to be proposed, funded then implemented by outside vendors. The approved reading/language arts IDSs and mathematics IDSs were run by for-profit education institutions. In the initial year of the program, seven proposals were accepted; 3 in science, and 2 each in math and reading arts. The three science IDSs were all run by local universities; Northwestern University, IIT/Field Museum, and Loyola University Chicago/UIC. These universities all participated in some capacity in CMSI, so they were well aware of the issues and concerns CPS has had with science and mathematics instruction, and have a track record with working with CPS teachers. The initial two math IDSs were Agile Mind (of the Dana Center at the University of Texas at Austin) and Cognitive Tutor (of Carnegie Learning).

Each IDS was required to develop several CPS-specified support components for teachers. These supports were: 1) a vertically cohesive pathway to required outcomes, 2) an infrastructure to support the outcomes, including materials, planning guides, model lessons and tools, 3) formative and
summative assessments dedicated to the courses, 4) intensive instructional coaching, 5) professional development targeted to instructional needs, 6) networking opportunities across schools using the same instructional materials.

CPS high schools were recruited to voluntarily select which IDS programs to use. Each year a new cohort of between [forthcoming] schools were new in IDS involvement. By 2007-2008 24 of the districts high schools were involved in implementing IDS systems. [See related evaluation reports].

OMS, OHSP, and Area high school math and science instructional leaders (2003-2008)

During 2003-2004, high school instructional leadership positions were added to the district with approximately seven of the 30 OMS staff members fully or partially focused on secondary math and science. There were also 12 newly structured Coaching positions created within the six CPS Area Instructional Offices. In each Area a Math Coach and a Science Coach were hired. External evaluators in 2004 documented some tensions with OMS staff feeling the high school efforts were understaffed by OMS employees and that the roles of Area coaches were not well defined or coordinated.

These leadership positions continued with structural changes including the transition of OMS positions to the CPS Office of High School Programming. As noted above, the HST IDS efforts also engaged instructional coaches working with teachers. [See related evaluation reports].

University-based math and science courses and tuition for high school teachers (2004 – 2008)

The reorganization of OMS had implications for tuition support of high school teachers seeking additional university coursework. When OMS had authority of K-12 science and math, the tuition subsidy policy applied to all K-12 science and math teachers. However, when OMS was reorganized to have authority only for K-8, the Office of High School Programs (OHSP) discontinued the tuition policy. As of fall 2008, only one program, Loyola’s Physics Endorsement Program (see below) continued to be supported by this policy since the program started before this reorganization, and OMS honored its commitments to these teachers. This program concluded in the spring semester of 2009.

Loyola University with support of a Math Science Partnership grant from the State of Illinois partnered with CPS on an endorsement program for CPS teachers. The data supporting the need for more and more qualified physics instructors in Chicago Public Schools was clear. Data compiled by the OMS indicated that there were only 65 teachers in the 107 CPS high schools who had either a major or endorsement in physics. Moreover, of the 362 sections of physics offered by all CPS schools in the fall of 2003, only 137 (37.8%) were taught by instructors having either a major or aligned endorsement in the field. Remarkably, 5/8 of all physics sections taught in CPS did not have instructors with either a major or endorsement in physics. To date 24 teachers had participated in this program, and eight teachers had so far completed all requirements to earn the Illinois endorsement in physics.

Systemic efforts to better address the need for these types of courses had been spurred recently by two funding streams. The 2007 call for proposal for funding from the Illinois State Board of Education Math Science Partnership grants required grantees to plan and implement master’s degree programs in math and science for high school or elementary teachers. Twenty-four new master’s programs had planning grants in 2008 with many of these aimed at high school teachers. Two of the planning grants for programs with high schools teacher were with Chicago universities. Loyola
University proposed a new master’s degree for high school chemistry teachers and DePaul University proposed one for high school environmental science teachers. The 2007, 2008 and 2009 National Science Foundation requests for proposals for Math Science Partnerships spurred proposals from five Chicago area universities to create Chicago Transformation Teacher Institutes (CTTI) that would serve math and science administrators and teachers from Chicago high schools.

Two different types of CPS approved programs were created so that high school teachers completing them would obtain credentials including: High School Math Endorsement and High School Science Endorsement. Each program sequence had a different number of classes necessary for completion. The high school math program was comprised of 12 classes and led to a Master’s degree in mathematics.

Table 8. Number of district supported classes offered per academic year by program type

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<tbody>
<tr>
<td>High School Math</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>19</td>
<td>na</td>
<td>na</td>
<td>na</td>
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<tr>
<td>High School Science</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>41</td>
<td>64</td>
<td>98</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>236(^{15})</td>
</tr>
</tbody>
</table>

Under current legislation, in order to obtain a high school endorsement in math or science in this state a teacher must have completed:\(^6\):

- a major in the content area listed on the transcript, or
- 32 semester hours in the content area, or
- 24 semester hours in the content area and pass the content-area examination (as of July 1st, 2004).

[See related evaluation reports].

IDS/HST assessment data (2006-2008)

[Forthcoming -- on HST assessment systems and activities]

For example, all of the math and science IDS programs use extensive formative assessment as part of their support to teachers during their work with them during the school year. The LUC-UIC Science IDS provides its teachers with a customized report allowing them to compare the aggregate performance of their students on each test item with the performance of others at their school, with students at all schools in the IDS, and with last year’s data for the same item if available. [See related evaluation reports].

iii. Evolution

It is clear from this paper that many programs and other efforts in this reform occurred not as fully-formed plans, but evolved from programs and efforts that preceded them. The reform has been a

\(^{15}\) There were four classes to which we were unable to assign a program description. We are working with the program coordinators to resolve this.

\(^{16}\) These are the new requirements as of July 1, 2004.
continuously formative process, and it is useful to look back at the whole and examine which programs came out of the most successful ideas preceding them. As this process of reform includes a temporal element, an element of heritability, and external pressures which lead to the generation of new species of programs, it is useful to look at mathematics and science reform in Chicago in an evolutionary way. We have adapted the use of a cladogram, a diagrammatic system used by evolutionary biologists to trace the lineages of emerging species over time. The appearance of specific characteristics at the branch points alert us to the nested set of characteristics each downstream species possesses. In figure X we indicate time across the top, and indicate the participants undergoing the evolutionary change on the left side. Along the bottom we explain the evolutionary traits which lead to the nodes or branch points from the original program. We have created separate evolutionary diagrams for Teacher Content Knowledge, Specific Curricula and Professional Development, and Instructional Leadership. These diagrams can be overlaid, so as to see the parallel changes which occurred in these different arenas, at the same time, or as a result of common pressures. Using a diagram like this we can indicate which programs actually stopped, which continued primarily as originally implemented, and which underwent a change to yield different programs. We find this is a useful way to see the relationships between the various activities which have occurred throughout this period of reform.

If we map programs at CPS related to selected strategies across time and look for evolutionary issues that might account for transitions in program operation, we have the following:

Figures 9, 10, 11: Evolution and Transitions in Program Operations of the CMSI, 2002 - 2008
<table>
<thead>
<tr>
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<td><strong>For Elementary</strong></td>
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<tr>
<td>Middle grades science programs</td>
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<td>Algebra Initiative (middle grades) programs</td>
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<td><strong>For High Schools</strong></td>
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<td><strong>Who enrolled at universities</strong></td>
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<td>Ts who need NCLB HQ status</td>
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<td>Volunteer Ts</td>
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<td><strong>Evolutionary traits</strong></td>
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<td>CONTENT course focus</td>
<td>PROGRAM focus</td>
<td>PARTICIPATION related to threat to job security</td>
<td>School–wide PARTICIPATION</td>
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<td>Primarily NSF FUNDS</td>
<td>Participation contract and policy</td>
<td>MIXED state, private, district, university FUNDS</td>
<td>Possible T specialization policy</td>
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<tr>
<td><strong>What offered for schools</strong></td>
<td>2 primary, 2 middle grades curricula</td>
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<td>Showcases for schools</td>
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<td></td>
<td>(AIMS selection process by OMS)</td>
<td>Single science cope and sequence</td>
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<td>3 math IDS sequences</td>
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<td>3 science IDS sequences</td>
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<td>IS schools Ts</td>
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<td>Mandated probation schools Ts</td>
<td>Cluster 4 middle grade school Ts</td>
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<td>Voluntary Ts or schools</td>
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<td><strong>Evolutionary traits</strong></td>
<td>Publishers with teachers teach PD</td>
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<td></td>
<td>University staff with teachers teach PD</td>
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<tr>
<td></td>
<td>OMS Science and Universities train teachers to lead PD</td>
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<td></td>
<td>OMS centralizes PD leader program</td>
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<td>Primarily NSF FUNDS</td>
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<tr>
<td></td>
<td>MIXED state, private, district, university FUNDS</td>
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</tr>
</tbody>
</table>
INSTRUCTIONAL LEADERSHIP

Who hired and trained for what roles

**Elementary and High School**

**2002-2003**
- OMS created
- Chief Officer Gartzman, Math Director Slaughter, Science Director Lach
- Evaluation unit within OMS, Feranchak

**2003-2004**
- Chief Officer
- Lach, Math Director Slaughter
- Science Director Lach

**2004-2005**
- Chief Officer
- James, Math Director Tavormina
- Science Director Bartley

**2005-2006**
- Chief Officer
- DOPE, Director Feranchak

**2006-2007**
- 3 month Leadership Academy
- Principal CMSI PD
- No prin pd

**2007-2008**
- Future shift

**Future shift**
- Who hired and trained for what roles

**Elementary**

- Area MS Coaches funded by OMS
- Magnet Cluster Specialists
- TLI IMSP professional development
- City-wide Specialists for 3 probation schools
- Cluster 4 Coaches
- School Specialists for each IS school funded by OMS
- OMS Elementary Facilitators

**High School**

- Area Math and Science Coaches funded by OMS
- Math Science
- HS to OHSP
- OMS stops funding in-school Specialist positions
- OMS stops funding Area Coaching positions

**Evolutionary traits**

OMS stops funding in-school Specialist positions

- OMS stops funding Area Coaching positions

**Future shift**
- Who hired and trained for what roles

**Future shift**
- Who hired and trained for what roles

**Future shift**
- Who hired and trained for what roles

**Future shift**
- Who hired and trained for what roles

**Future shift**
- Who hired and trained for what roles
d. Evaluation

One of the first positions created within the newly created Office of Math and Science in 2002 was that of Evaluation Specialist. The Evaluation Specialist served on the OMS Lead Team and worked with the Chief Officer and senior staff to design the Chicago Math and Science Initiative and, more specifically, to assess the needs of the district and to design and manage a formative and summative evaluation plan for OMS activities. In parallel to the creation of this internal evaluation, the Chief Officer of OMS also hired an external evaluation team to work in partnership on the design and implementation of the evaluation plan for OMS. Significant resources were dedicated to this function. [Details forthcoming]

i. Key choices shaping OMS evaluation design

In designing the evaluation activities for a complex portfolio of OMS activities begun in 2002, several key choices were made: a strategic and phased in approach, a combination of internal and external evaluators, mixed methods, and a strong focus on formative evaluation as well as summative evaluation of outcomes.

Necessity of a strategic plan and phased-in approach

Cognizant that it would not be feasible, nor desirable, to attempt to evaluate all aspects of a systemic initiative at once, strategic choices were made. The first step was to develop an evaluation framework which provided a way of organizing the evaluation efforts. The framework also provided a coherent template for future evaluation activities as more resources became available and different aspects of the initiative occurred. From this framework, annual evaluation plans could be developed while considering how the evaluation activities were coordinated and not redundant.

For example in 2003-04, program leaders and evaluators decided to focus efforts around the following key program activities: adoption of standards-based mathematics and science instructional materials in the elementary school, human infrastructure development, universities courses leading to teacher endorsements and NCLB highly-qualified status in math and science, and student high school course taking patterns and pass rates. Within each of these areas key evaluation questions were formulated and evaluation activities including data collection were determined.

Centrality of internal and external evaluation

The decision was made in fall 2002 to employ evaluators both internal and external to the district. The internal evaluators were seen as having several strengths in terms of intimate knowledge of the program design and logistics, relatively rapid ability to share data with key stakeholders in the district, mathematics and science content expertise and daily access to other district evaluators and data. The external evaluators were seen as contributing complementary strengths including objectivity, confidentiality, expertise in large-scale qualitative field studies and additional evaluation capacity.

Directing the internal evaluation at the CPS OMS, the Evaluation Specialist attended the planning meetings for all major CMSI activities and thus was able to share data that could inform the planners’ decisions, document the planning process, and make sure that the implementation of activities included a plan for their evaluation from their initiation. During 2003 – 2006 the Evaluation
Specialist and his one full-time and two part-time staff researchers brought expertise in evaluation using statistical analysis of surveys and databases and in analysis of math and science content. Additionally, they coordinated and leveraged other district evaluation resources such as district collected data and other district evaluation staff.

The external evaluation team from University of Illinois at Chicago offered OMS a way to learn from interview, observation, and other data from CPS staff that could only be validly collected with the promise of holding identities of individuals and schools confidential. Besides issues of confidentiality the external evaluators brought objectivity necessary to the evaluation since they had a professional distance from OMS and CPS. During 2003 to 2005 the university-based external evaluation team was comprised of one member of the research faculty, two full-time research professionals and five part-time graduate students. The team was funded 100% on external contracts and grants and had great flexibility in starting new projects and hiring new staff. Further, employing talented graduate students both full- and part-time was relatively cost-effective and mutually beneficial for what they contributed to the project and the experience that they gained. The external evaluation team brought experience in evaluating district-wide reform efforts and in mixed method evaluation with particular expertise in qualitative data collection and analysis. This increased the district’s evaluation capacity.

Multiple evaluation methods

As experienced evaluators of NSF projects have learned in the past, using mixed methods has great advantages (Frechtling & Sharp, 1997, p. 1-2). The evaluation of OMS efforts used different methods to collect and analyze data and matched method with the question to be addressed – and when possible, used multiple methods to collect data so as to triangulate findings from various sources. In addition certain data were used to address multiple questions and thus minimize costly data collection activities and redundancies. Given the highly political context of educational reform, particularly in Chicago, the use of multiple methods helped OMS speak to the different stakeholders – from those who wanted to ground everything in student test scores to those who wanted to understand in rich detail how a new policy plays out at a typical school and how teachers make sense of it.

Evaluation activities included collection of data from interviews, large-scale surveys, targeted surveys, observations, structured written reflections, and focus groups as appropriate, as well as large-scale test scores. Analysis of these data utilized various statistical analytical techniques and both quantitative and qualitative analysis of textual data. Respondents included district leaders, OMS staff, professional developers, school principals, participating teachers and students, and university instructors.

Formative process evaluation

Due to the long-term nature of many of the activities of systemic initiatives it was crucial for formative evaluation to be implemented in addition to summative evaluation. For example, some of the key activities of CMSI from 2002 to 2004 centered on offering professional development experiences to practicing teachers. In 2002-2003 alone, CMSI activities engaged 3,153 teachers in professional development activities that linked math and science content knowledge with pedagogy. This strategy of developing strong human resources who will then carry out stronger instruction in classrooms offered a means to making lasting changes in CPS. However, these changes would not be made instantly. Changing teachers’ beliefs about teaching and their instructional practices took time...
and sustained efforts. Yet the CMSI strategy relied on this as the best means to improve and institutionalize a standards-based culture in the district. The length of time needed for these changes made it unwise to wait only for summative outcomes – like changes in student test scores to signal whether or not the program works. Rather, there was a need to understand the process of teaching professional development – what was working well and what was not – and then make mid-course corrections in this process as quickly as possible. Furthermore by taking this approach it would be easier to explain why certain outcomes occur (e.g. test score improvement).

Formative evaluation is relatively ineffective unless it gets considered in a timely fashion as program activities are planned, reassessed, and changed. In order to facilitate this usage, the internal evaluator met weekly with other senior level OMS leaders and provided input into program planning, utilizing internal evaluation data. Based on weekly meetings with the external evaluators, he brought insights that they had gathered to OMS senior staff meetings. Evaluation reports were written with formative feedback in mind and delivered first as “interim” reports with the understanding that later more summative reports would be filed. The internal evaluators and the external evaluation team also worked to provide formative feedback most effectively by facilitating dialogue of OMS staff around the findings from reports. This proved useful to both those making program decisions with a basis in data from prior efforts and to evaluators who could better gauge what types of data the decision makers would find helpful in their next round of decisions.

**ii. Public sharing of evaluation reports by the district**

The following is a list of evaluation reports and papers relative to math and science education available from the CPS Department of Program Evaluation. They are listed by subject. These are available at the CPS Department of Program Evaluation website at [http://research.cps.k12.il.us/cps/accountweb/Evaluation/View_Evaluation_Reports/](http://research.cps.k12.il.us/cps/accountweb/Evaluation/View_Evaluation_Reports/). The evaluation of much of the math and science elementary school efforts has been publicly shared since 2003 by the district on their websites. In addition, the PRAIRIE Group at UIC, with the district’s permission, makes its external evaluation reports of CPS programs available on its website at [http://www.prairiegroup.org/home.html](http://www.prairiegroup.org/home.html). In the Appendix is a list of the internal and external evaluation reports on the CPS Department of Program Evaluation website.

**e. Logic Models of Chicago Math and Science Reform**

An important way to understand the vision of Chicago Public Schools leaders is to review their documentation of what they hoped to achieve. When available, logic models or goal statements can be useful tools.

**i. CMSI logic model and outcome map**

As a first step and foundation for evaluation planning, evaluators worked with OMS leadership to draft a logic model and outcome map.
**Goal:** Students demonstrate enhanced engagement, learning and achievement in mathematics and science

<table>
<thead>
<tr>
<th>Long Term Outcome 1:</th>
<th>Long Term Outcome 2:</th>
<th>Long Term Outcome 3:</th>
</tr>
</thead>
<tbody>
<tr>
<td>High quality classroom instruction in math and science will occur</td>
<td>Increased workforce capacity and competency in math and science content knowledge and pedagogy</td>
<td>Sustainable infrastructure (at school, instructional area, and district levels) and coherent policy directives in math and science will be created</td>
</tr>
</tbody>
</table>

**Intermediate Outcomes:**

| A) Increased use of high quality curricula and assessment tools to improve math and science instruction | A) Increased number of highly qualified in-service teachers developed through partnerships with local universities | A) Adoption of a shared coherent vision of math and science teaching and learning |
| B) Teaching and learning as a hands-on/minds-on interactive instructional approach that includes collaborative student investigation, discovery, and application of relevant math and science content | B) Increased participation in high quality professional development | B) Alignment of math and science curricula, instructional strategies, assessments, and professional development offerings |
| C) Teaching and learning of intellectually demanding material where students communicate and construct knowledge | C) Creation of active practitioner networks (teachers, principals, AIO’s), both within and across schools, to facilitate long-term support in high quality math and science practice | C) Coordination of internal and external partnerships to support coherent delivery of math and science offerings. This includes Consistency of university course sequences to support the district’s workforce needs |
| D) Teachers use materials, strategies, and perspectives sensitive to the needs of students with diverse: Cultures Languages Genders Learning styles | D) Practitioners demonstrate increased content knowledge and understanding of fundamental concepts in relation to teaching math and science | D) Allocation of financial, human, time, and facility resources to support math and science programming for all students |
| E) Teaching and learning of material that is appropriately paced to introduce students to new concepts as they progress through grade-levels | E) Coherent leadership which advocates for, supports, delivers, and manages math and science offerings | |
| F) More classroom time on math and science instruction | | F) Strong professional communities of practice for teachers and staff supporting their work. |
Students demonstrate enhanced learning and achievement in math and science. Improved classroom instruction in math and science leads to increased workforce capacity and competency in math and science content knowledge and pedagogy. Improved systemic connections and coherent policy directives involving math and science to support and sustain meaningful organizational and institutional transformation.

1.A) Increased use of high quality curricula and assessment tools to improve math and science instruction
1.B) Teaching and learning as a hands-on/minds-on interactive instructional approach that includes collaborative student investigation, discovery, and application of relevant math and science content
1.C) Teaching and learning of intellectually demanding material where students communicate and construct knowledge
1.D) Teachers use materials, strategies, and perspectives sensitive to the needs of students with diverse:
   - Cultures
   - Languages
   - Genders
   - Learning Styles
1.E) Teaching and learning of material that is appropriately paced to introduce students to new concepts as they progress through grade levels
1.F) More classroom time on math and science instruction

2.A) Increased number of highly qualified in-service teachers developed through partnerships with local universities
2.B) Increased participation in high quality professional development
2.C) Creation of active practitioner networks (teachers, principals, AIO’s) to facilitate long-term follow-up in high quality math and science practice
2.D) Practitioners demonstrate increased content knowledge and understanding of fundamental concepts in relation to teaching math and science

3.A) Adoption of a shared coherent vision of high quality math and science teaching and learning
3.B) Alignment of math and science curricula, instructional strategies, assessments, and professional development offerings
3.C) Coordination of internal and external partnerships to support coherent delivery of math and science offerings
3.D) Allocation of financial, human, time, and facility resources to support math and science programming for all students
3.E) Coherent leadership which advocates for, supports, delivers, and manages math and science offerings
3.F) Strong professional communities of practice for teachers and staff supporting their work
3. MATH AND SCIENCE EDUCATION REFORM THROUGH SYSTEMIC LENSES

Using both the systemic and analytic frameworks we described in Section 1 and referring to the context of Chicago school reform efforts described in Section 2, we tell the stories and accounts of several key strategic reform initiatives here in Section 3. Specifically we look at efforts to support:

a. Curricular materials that are standards based
b. In-service professional development
c. Human resource supports strategies around curriculum use and instruction
d. Assessment systems
e. Content knowledge depth in math and science for teachers

The accounts we give in this Section are drawn from data and documents describing programs 2002 – 2008. In the appendices in Section 5, we include a listing of the original evaluation reports that document the activities and impacts of Section 3 key strategic reform initiatives.

a. Curricular Materials that are Standards Based

The use of standards-based curricular materials was at the heart of elementary and high school math and science reform efforts in Chicago during 2002 to 2008. The increased use of these materials, particularly those selected as preferred curricula by the district, was great. We review the context that shaped this focus on curricular materials, the vision and re-vision of curricular usage, and issues suggestive of the sustainability of this facet of systemic reform in Chicago.

i. Context

The state of research-based knowledge, the situation in the Chicago Public Schools related to local schools’ control over their budgets and to high student mobility, and the capacity of Chicago area universities around math and science K-12 curricula set the stage for the district’s choice to build its reform strategy around a small number of preferred curricula.

Research literature

The decision on which curricular materials to adopt has been central to systemic reform efforts in mathematics and science. This is perhaps not surprising given the ubiquitous nature of textbooks in both the U.S. (Tyson-Bernstein & Woodward, 1991) as well as internationally (Robitaille & Travers, 1992). These studies both noted that textbooks were a prominent, if not dominant, part of teaching and learning. Several studies have noted the significant influence that textbooks and materials have on classroom instruction (Stigler & Hiebert, 1999; Valverde & McKnight, 2000; Weiss, et al., 2001; Schmidt, McKnight, et al., 2001; Schmidt, Huong, & Cogan, 2002; Chavez, 2003). In fact, research has shown that the process of investigating and implementing curriculum can enhance a teacher’s knowledge of the subject matter and improve instruction (Ball & Cohen, 1996; Reys, et al., 1997). Thus it is not surprising that a district interested in profoundly impacting classroom teachers and their instructional practice would base its systemic reform efforts on the decision to implement challenging standards-based curricula based in current research on learning (NCTM, 1989, 2000; Reyes, Robinson, Sconiers, & Mark, 1999; Trafton, Reys, & Wasman, 2001).

[Forthcoming paragraph on standards-based, inquiry-oriented, reform math and science curricula and how students learn]
These types of curricula share, among other characteristics, a student-centered and not teacher-centered focus. Teachers are facilitating student exploration of a science concept through inquiry activities, or are encouraging students to solve problems in novel ways rather than presenting a single method of arriving at a solution. Many teachers have not used these student-centered and inquiry-oriented styles. Therefore, teachers using these curricula need to learn a new way of teaching. The adoption of reform standards-based curricula requires a different skill set in the teaching of science and mathematics than the teacher may be used to implementing. National teaching standards in science and mathematics delineate many of these skills (NRC 1996, NCTM, 1991). Affecting substantive change in the technical core of teachers’ work is difficult (Condliffe Lagemann, 2000; Tyack and Cuban, 1995; Smylie, 1995).

Local control and high mobility

The decision of what instructional materials a CPS school uses rests legally by Illinois law with each individual school principal and Local School Council (LSC)—a group comprised of teachers, parents, and community representatives. This local control over curricula choice has been in place since 1988 and by 2002 there were many different types of materials in Chicago’s roughly 500 elementary schools and 100 high schools. A 2002 survey of schools by the new Office of Mathematics and Science revealed 86 different math and 43 different science textbook series in use at elementary schools. Dozens of different textbooks were being used for each of the core high school mathematics and science courses. For example, 55 different biology, 47 different chemistry, 31 different physics, 25 different earth and science, 28 different environmental science, 34 different algebra, 20 different geometry, and 22 different trigonometry textbooks were identified.

The 2002 survey revealed that curricula and textbooks were “in use” in a very general way. The schools indicated they used these texts but it remained uncertain to what extent this meant all teachers taught from these texts daily or if a few teachers used the texts to supplement their instruction. District leaders believed there was wide variation within and across schools.

Students attending the Chicago Public Schools in 2002 were a highly mobile population. While the district average mobility rate registered around [forthcoming]%, some schools had yearly mobility rates as high as 50%.

Curriculum expertise in Chicago

In 2002, Chicago was home to a rich community of math and science curricula design and support specialists based at local universities. The University of Illinois at Chicago Institute for Math and Science Education was home to the authors of the Math Trailblazers K-5 curriculum and were also providing support to teachers, schools and families (See http://www.math.uic.edu/~imse/IMSE/MTB/mtb.html). The managing director of that Institute was Marty Gartzman, who became the first CPS Chief Officer of Math and Science in late 2002. At the University of Chicago, the School Math Project was home to the authors of Everyday Mathematics for pre-K to grade 6 students. The Project also had NSF funding to support “educators, parents and students who are using, or will soon be using, Everyday Mathematics” (See http://everydaymath.uchicago.edu/). At Northwestern University, the Center for Learning Technologies in Urban Schools (LéTUS) was an NSF-Funded Center for Collaborative Research on Learning Technologies. Various science curricula were developed through this Center and though the NSF grant that established the Center funding ended in 2004, its work continued through other sources of funding.
Other university expertise was also available in Chicago that was soon harnessed to support math and science K-12 curricula. New to the University of Illinois at Chicago, a new Learning Sciences Research Institute was beginning in 2001. Jim Pellegrino, one of the authors of How People Learn (2000) co-directed this Institute. Another new group, the Center for Science and Math Education at Loyola University Chicago began in 2001 with expertise in biology and physics workshops for teachers. In addition, numerous individual math and science faculty members and groups at these and other universities had been involved in teacher education and were pulled into roles on curricula review committees.

Selecting elementary school CMSI-supported curricula

The Chicago Public Schools created a new Office of Mathematics and Science (OMS) in 2002 and OMS leaders studied the research literature and district contextual issues. In light of these, they came to the conclusion that while good math and science instruction could be achieved with any number of curricular materials, district policy needed to recognize that:

- Because of high student mobility between schools there were advantages for the students if they were not also always shifting into different curricular materials.
- Limited resources needed to be strategically focused to develop deep instructional leadership expertise and assessment systems.

Mobile students experiencing different curricular materials each time they changed schools was judged by district leaders to be a potential barrier to students’ achievement. With no commonality in the tools and materials being used by schools, the district’s curriculum offices were forced to resort to generic professional development strategies that likely had only limited effect on teacher learning and student achievement. Additionally, it was difficult to develop district level benchmark assessments that aligned well with the instruction being provided to students.

The district push for schools to use the specified curricula was made with the hope that there would also be shared use of tools and resources both within and across schools. For example, teachers in the same grade level could use the same guides to pacing and student assessment which were closely aligned to their own classroom curriculum. Classroom observation guides could be developed and used by colleagues to observe and discuss classroom instruction. Professional development closely tied to the specific curriculum, grade-level, and expertise level (e.g., new or experienced user) of the teacher could be provided for and attended by teachers. In addition, teachers could make use of the human infrastructure supports the district made available (which will be discussed in much more detail in a subsequent chapter) to help with the implementation of the district supported curricula. Finally, teachers could participate in a network of peers who were also implementing the same curriculum using a common language and framework to discuss instruction and student learning.

Early in 2002-03, OMS leaders made critical decisions to rectify this curriculum fragmentation by grounding reform efforts in support for the implementation of a small set of research-based curricula. Two K-5 and two 6-8 mathematics programs, as well as a single sequence of kit-based science programs, all developed with NSF funding, were identified for district-level support. For primary level math the district staff chose:

- Everyday Math and
- Math Trailblazers.

For middle grade math, they chose:
• Connected Math and
• Math Thematics.  

The elementary science curricula were chosen to follow a “Scope and Sequence” (http://cmsi.cps.k12.il.us/ViewProgramDetails.aspx?pid=337 or http://cmsi.cps.k12.il.us/Files/DownloadFile.aspx?ID=15928) of topics outlined by OMS to be aligned to the Illinois State Standards and assessment frameworks. These science curricula units were drawn from

• FOSS (Full Option Science System),
• SEPUP (Science Education for Public Understanding Program),
• IES (Investigating Earth Systems), and
• STC (Science and Technology for Children).  

All of these programs were developed with the support of the National Science Foundation.

A year later, a small set of textbooks were identified for each core course in high school mathematics (Algebra, Geometry, Algebra II) and science (Biology, Chemistry, Physics, Earth and Space Science, Environmental Science). A curriculum selection process was carried out that involved 14 committees engaging over 70 teachers, curriculum leaders and content experts.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra 1</td>
<td>Algebra 1: Glencoe Mathematics – Illinois Edition</td>
<td>Glencoe McGraw Hill; University of Texas - Austin</td>
</tr>
<tr>
<td></td>
<td>bundled with Agile Mind online resources</td>
<td></td>
</tr>
<tr>
<td>Algebra 1</td>
<td>Discovering Algebra: An Investigative Approach</td>
<td>Key Curriculum Press</td>
</tr>
<tr>
<td>Algebra 1</td>
<td>UCSMP Algebra 1</td>
<td>Prentice Hall</td>
</tr>
<tr>
<td>Algebra 1</td>
<td>Cognitive Algebra Tutor</td>
<td>Carnegie Learning</td>
</tr>
<tr>
<td>Algebra 1</td>
<td>Interactive Mathematics Program (IMP)– Year 1</td>
<td>Key Curriculum Press</td>
</tr>
<tr>
<td>Geometry</td>
<td>Geometry: Glencoe Mathematics – Illinois Edition bundled with Agile Mind online resources</td>
<td>Glencoe McGraw Hill; University of Texas - Austin</td>
</tr>
<tr>
<td>Geometry</td>
<td>Discovering Geometry: An Investigative Approach</td>
<td>Key Curriculum Press</td>
</tr>
<tr>
<td>Geometry</td>
<td>UCSMP Geometry</td>
<td>Prentice Hall</td>
</tr>
<tr>
<td>Geometry</td>
<td>Cognitive Geometry Tutor</td>
<td>Carnegie Learning</td>
</tr>
<tr>
<td>Geometry</td>
<td>Interactive Mathematics Program (IMP)– Year 2</td>
<td>Key Curriculum Press</td>
</tr>
</tbody>
</table>


18 Information on elementary science curricula can be found on the OMS websites. For science please see http://cmsi.cps.k12.il.us/ViewNewsDetails.aspx?pid=77&id=6150.
Leadership Academy process of choosing curricula for district support

Every workday afternoon in November 2002 through January 2003, the staff of the newly formed CPS Office of Mathematics and Science (OMS) met for their Leadership Academy professional development sessions. Twenty-seven afternoons, little less than half of these sessions were spent in presentations and discussions about standards-based curriculum. Another three afternoons were used to discuss the experiences staff were having during their mornings when they were in schools teaching math or science using some of the curricular materials under consideration. During the Leadership Academy sessions focused on curricular materials, invited experts and experts within the OMS staff gave presentations, engaged participants in discussions, or provided opportunities for participants to utilize new skills or materials related to specific curricula. The qualities of the sessions varied according to external evaluators’ observations of a sample of these afternoon meetings. In approximately 25-30% of observed presentations on specific curricula, curriculum vendors gave a relatively “canned” presentation, providing an overview of materials and engaging participants around them in a limited and formal manner. In 70-75% of observed curriculum presentations, presentations were more interactive and incorporated information or discussions about the Chicago context.

Of these days devoted to the presentation of curricula, a little more than half were devoted to the consideration of standards-based math programs and approximately thirty-seven percent was devoted to science. In total, about a dozen standards-based mathematics and science curricula were presented at the Leadership Academy. Fewer science programs were presented. According to OMS leadership, this was due to time constraints caused by a longer amount of time needed to set up materials for the science lab sessions, and to a greater focus by Academy planners on mathematics.

Comments from participants and observations of the evaluators reflect openness to new learning, concern about time allotment, and general praise of the sessions. In general, comments made in 2003 interviews with external evaluators about Leadership Academy curricula presentations were very positive. For some OMS staff, standards-based approaches to curricular materials were completely new. One participant noted

<table>
<thead>
<tr>
<th>Course</th>
<th>Textbook Title</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Algebra Trig</td>
<td>Discovering Advanced Algebra:</td>
<td>Key Curriculum Press</td>
</tr>
<tr>
<td></td>
<td>An Investigative Approach</td>
<td></td>
</tr>
<tr>
<td>Advanced Algebra Trig</td>
<td>UCSMP Algebra 2</td>
<td>Prentice Hall</td>
</tr>
<tr>
<td>Advanced Algebra Trig</td>
<td>Interactive Mathematics Program (IMP)–</td>
<td>Key Curriculum Press</td>
</tr>
<tr>
<td></td>
<td>Year 3</td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>Biology The Dynamics of Life</td>
<td>Glencoe McGraw Hill</td>
</tr>
<tr>
<td>Biology</td>
<td>BSCS A Human Approach</td>
<td>Kendall/Hunt</td>
</tr>
<tr>
<td>Biology</td>
<td>BSCS An Ecological Approach</td>
<td>Kendall/Hunt</td>
</tr>
<tr>
<td>Biology</td>
<td>Biology Exploring Life</td>
<td>Pearson Prentice Hall</td>
</tr>
<tr>
<td>Chemistry</td>
<td>Chemistry in the Community</td>
<td>Freeman</td>
</tr>
<tr>
<td>Chemistry</td>
<td>Chemistry Matter and Change</td>
<td>Glencoe McGraw Hill</td>
</tr>
<tr>
<td>Chemistry</td>
<td>Chemistry</td>
<td>Holt</td>
</tr>
<tr>
<td>Earth Science</td>
<td>Earth Science</td>
<td>Glencoe McGraw Hill</td>
</tr>
<tr>
<td>Earth Science</td>
<td>EarthComm</td>
<td>It's About Time</td>
</tr>
<tr>
<td>Environmental Science</td>
<td>Environmental Science</td>
<td>Holt</td>
</tr>
<tr>
<td>Environmental Science</td>
<td>Science and Sustainability</td>
<td>Lab-Aids</td>
</tr>
<tr>
<td>Environmental Science</td>
<td>Looking at the Environment</td>
<td>Northwestern University</td>
</tr>
<tr>
<td>Physics</td>
<td>Physics</td>
<td>Holt</td>
</tr>
<tr>
<td>Physics</td>
<td>Active Physics</td>
<td>It's About Time</td>
</tr>
<tr>
<td>Physics</td>
<td>Conceptual Physics</td>
<td>Pearson Prentice Hall</td>
</tr>
</tbody>
</table>
I had never used any of the curricula so it was all new to me. I am a textbook person. I’m changing! So when you don’t have any base to go from, everything is new. It was great!

Nearly universally, participants reported that they gained a tremendous amount of knowledge from being exposed to the standards-based curricula. Participants reported that as educators with expertise in math, they were happy to spend time engaging in science activities while those educators with expertise in science were thankful for exposure to math. One science educator described this new learning as “opening my eyes to how much fun math could be for the students.” Half of the interviewed participants reported that they wished there had been more emphasis on science, and this comment appeared in written reflections collected by evaluators as well. One participant succinctly stated, “There seemed to be a heavy emphasis on math. I would have liked to have more science” while another participant developed this more fully.

So it was a very good experience, learning about the curriculum...But we didn’t have quite enough of the science I felt...I am hoping that at some point we have to learn about the science aspect, the different science curriculum. Because I think a lot of the math people are really not aware of what the science is like.

The OMS staff who attended but were not part of the team that planned the Leadership Academy explained to evaluators that they were uncertain as to how the decisions were made about the length of time devoted to each curriculum. “One would be two weeks and then another one would be given two days… If it’s going to be three days, let’s have three days for everybody, you know.” Similarly, another participant wondered how the specific curriculum had been chosen; suggesting that if the focus was on NSF supported curriculum, that the Leadership Academy should have included exposure to all of these curricula in equal time allotments:

If you’re going to do NSF funded curricula then we should have them all in. We had....Math in Context, fantastic! I loved it! But he only had an hour! That’s an NSF program so why didn’t he get three afternoons? It seemed as though some programs were pre-recommended before we even had a chance to look through them...I know you can’t have everybody because we have to limit, but maybe there is another good one that we didn’t get to see...So if you are going to do the curricula, you need to do all of them, and equally.

There were also comments, in hindsight, about the scheduling of the presentations. In retrospect, a planner of the Leadership Academy suggested:

There should have been breaks in between the days for the groups to properly collaborate and talk about what they had experienced with each of the [curricula] In other words if we had an Everyday Math program for three days and on the fourth day there would have been some...time...with structured activities to drive reflection of a Specialist about what did you gain? Do you want to pursue this more? What else about this program do you need to study to find more information about? And what doubts do you have about it? I would like to have had more time for that. Instead we just scheduled programs day after day, week after week.

Another planner noted that even though the three-month time period was extremely generous, it gave time for only an overview of the presented curriculum and “it would be really great to be able to observe...the lessons over a longer period of time.”
Evaluation team observations of the curricula presentations reveal a variation in the extent to which these sessions were tailored to the Chicago context. Likewise, these presentations varied in how well they incorporated opportunities for participants to reflect on the particular curricula within the context of possible CPS implementation and to engage in discussion about the new ideas presented. The evaluation team was not alone in observing these variations. The majority of interviewed participants perceived this and suggested that presenters could have been more prepared to tailor their presentations to CPS and OMS needs. The same participants noted that the sessions that were led by teachers were more useful to them than those directed primarily by vendors:

> When the teachers came in to share what they were doing in teaching the curriculum was much more valuable for me than to have the general salesperson come in because it added a layer of understanding... For example, [a teacher presenter] came in...and she talked about things such as classroom management...And we saw a video and she talked about what she thought the students were thinking. And that's totally different...from going to a workshop and getting a worksheet that teachers give to the kids...And for me it was not as rich...as when teachers talked about the things that they saw going on in the classroom. The specifics of the activities...really doesn’t matter, you know? What matters is what that teacher is thinking about her kids and what they’re doing, what they’re learning. Totally different way of thinking.

Researcher observations indicate that presentations that took place later in the Academy appeared to better allow for richer contextual discussion. It is difficult to determine whether this was because of a more specified description of need on the part of OMS staff to vendors, or whether participants were simply more empowered to ask questions regardless of vendor intentions.

**Building curricula through High School Transformation proposals**

The district selected published math and science curricular materials for elementary math and science and, initially, specified preferred textbooks for high school core courses. However by 2005, the Chicago Public Schools in partnership with the Gates Foundation chose a different but related process to commission the building and implementation of new integrated 3-year math and science curricular systems as part of their High School Transformation Project. As described in the Request for Proposals solicitation to potential vendors, CPS sought aligned 3-year sequences of courses in mathematics and science. Each option, known as an “instructional delivery system” or “IDS” involved extensive professional development for teachers and principals, an aligned set of psychometrically reliable and valid formative and summative assessments, in-classroom supports for teachers including curriculum coaches, as well as the necessary student and teacher curriculum materials including lab ware in the case of the science curriculum. The selected high school math and science IDSs each specified courses designed using curricular texts and materials, many developed with NSF support. For example in science the curricular materials were adapted to integrate the biology, chemistry, physics, and earth sciences knowledge and skills students would learn across three years.

As of fall 2008, schools, representing well over one-third of the district’s high schools were in some phase of implementing one of these high school IDS curriculum strategies. The math and science IDS involved included:

- Illinois Institute of Technology Science [http://msed.iit.edu/ids/about/](http://msed.iit.edu/ids/about/)
Northwestern Science http://www.meaningfulscience.org/
Cognitive Tutor
EDC Math.
http://main.edc.org/newsroom/press_releases/chicago_schools_takes_new_approach_math

ii. Vision and Implementation

Coherent policies

Carrots and sticks: Motivating implementation in elementary schools

Office of Math and Science leaders recognized the local control environment of CPS and also understood that school improvement was more likely if schools voluntarily undertook it and brought to it some minimum level of capacity for change. They designed an initial plan for bringing their preferred curricula into schools accordingly.

The Chicago Math and Science Initiative introduced in February 2003 offered all elementary schools a chance to apply and become “Intensive Support” schools that would begin using the specified CMSI-supported math and/or science curricula and OMS would provide them for two years with professional development, funds for purchasing curricular materials, in-school instructional support, and an aligned assessment system. Of the 207 schools that applied, eighty-one schools were awarded the Intensive Support designation for 2003-2004. Because of the number of schools applying and the OMS not wanting to diminish enthusiasm for the program, OMS adopted an intermediary program for schools that applied but were not yet accepted to full participation in the program. Forty-nine schools were placed into this category—these schools were called Readiness schools. Although initial interest was higher than expected and planned for, this completely voluntary, opt-in, incentive-based program for promoting these elementary school curricula approach lasted only one year.

By 2004-2005, two situations significantly changed district policy and progress in terms of elementary schools using the CMSI-supported math and science curricula.

First, the district faced a budget shortfall. The incentive funds for Intensive Support Schools, while not cut completely, were diminished. No new Intensive Support Schools were named. About 25% of the existing Intensive Support Schools lost half of their support for a freed teacher to support in-school instruction. All of the Intensive Support Schools lost 30% of the funds they had originally counted on getting in 2004-2005 for purchasing curricular materials. While some principals picked up the cost to keep the supports in place, other schools lost the staff person who was trained to go into teachers’ classrooms and help them use the new curricular materials.

Second, in 2004-2005 the Chicago Public Schools went from dozens of schools on “probation” because of inadequate student performance on standardized tests to hundreds of schools on probation. A school could be put on probation by the district in 2003-2004 if less than 25% of its students met state standards. In 2004-2005, the benchmark for placing a school on probation was if less than 40% of a school’s students were meeting state standards. When a school was put on probation, they lost a
certain level of their local control over their budget and choices around curriculum and resource usage. For those probation schools where student achievement in mathematics was targeted in their improvement plans, district leaders required that the schools adopt CMSI-supported curricula and that their teachers attend professional development workshops on the use of these curricula.

Accordingly, in 2004-2005 and onward, the district found itself working to support a much larger group of new users of CMSI-supported math and science curricula—many of whom were teachers at schools where students were performing at very low levels of math and science achievement.

Table 10: Number of CPS Elementary Schools Supported by the District in Implementing Standards-based Curricula

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<tbody>
<tr>
<td>Science All</td>
<td>22</td>
<td>48</td>
<td>173</td>
<td>261</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Math All</td>
<td>59</td>
<td>162</td>
<td>322</td>
<td>379</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Totals</td>
<td>81</td>
<td>210</td>
<td>359</td>
<td>397</td>
<td>na</td>
<td>na</td>
</tr>
</tbody>
</table>

*Math Primary Details*

| Everyday Math                     | 22                                   | 61                                   | 72                                   | 107                                  | na                                   | na                                   |
|Math Trailblazers                  | 34                                   | 88                                   | 157                                  | 229                                  | na                                   | na                                   |

*Math Middle Grades Details*

| Connected Math                    | 24                                   | 51                                   | 91                                   | 146                                  | na                                   | na                                   |
|Math Thematics                     | 30                                   | 51                                   | 133                                  | 159                                  | na                                   | na                                   |

*Science Details*

| xxx                               | na                                   | na                                   | na                                   | na                                   | na                                   | na                                   |
|xxx                                | na                                   | na                                   | na                                   | na                                   | na                                   | na                                   |

[Forthcoming on characteristics of schools sending teachers to CMSI curricula professional development by 2008]

Ordering, receiving, and opening boxes: Logistics key to implementation

Getting the curricular materials into the schools, then into the classrooms, and then opening the boxes and preparing them for use was a significant challenge critical to the success of this systemic reform. The Office of Math and Science developed detailed listings with prices to guide schools on what they should order to supply their classrooms with the materials they needed to fully implement use of the new curricula. Principals at each school had to place their orders and sometimes followed the OMS guidelines but other times did not. The timing of the ordering and delivery process while working well for many schools, did not work well for other schools. Some teachers’ implementation of curricula was hampered by late arriving materials in 2003 and delayed materials continued to delay other teachers even into 2008.
In 2003-2004 the first year of CMSI in the Intensive Support Schools, the OMS-funded Specialists spent up to a third of their full-time job managing curricular materials. This was especially challenging for those managing the new science curricula where they had to quickly learn about all of the materials in the kits and help the teachers with the considerable preparation time for each lesson. By fall 2005 and beyond, the management of materials was part of the role for OMS-funded Citywide Specialists and school-based specialist, if available. However, managing the materials remained a time consuming activity and these staff were usually no longer full-time at a school. At times OMS and Area staff needed to step in and help resolve problems.

Workforce development

The overarching message delivered by the Office of Math and Science to schools using CMSI elementary math and science curricula was to implement these in the classroom as curricula authors intended. Professional development workshops and in-school coaching were aimed at preparing teachers to do that. To carry out this work, OMS named “implementation and support centers” at universities for particular district-supported mathematics and science curricula. Specifically, the University of Chicago’s Center for Elementary Math and Science Education became the support center for Everyday Mathematics, the University of Illinois at Chicago’s Institute for Mathematics and Science Education supported Math Trailblazers and Connected Mathematics, and Loyola University Center for Science and Math Education became the SEPUP science implementation and support center.

In addition the Teachers’ Academy for Math and Science, a statewide not-for-profit, provided training for teachers in 2003-2004 Readiness Schools to investigate the various curricula before making a specific selection of which curriculum to implement in the subsequent year.

For the high school science work, local universities (either the Illinois Institute of Technology, Loyola University, or Northwestern University) became the implementation and support center for each of the IDSs. The math high school IDSs took a different path without local universities as support sites.

Each of these institutions collaborated with the district to provide curriculum-specific, grade-specific, experience-level specific (new or experienced users) professional development for district leaders, teachers, and principals. A subsequent section considers in detail the professional development offerings delivered around these curricula.

Improved instruction

The assumption behind the CMSI was that if teachers used the curricula supported by the district, and used these materials as their authors intended, that classroom instruction would be improved. The CMSI Logic Model also described that high quality instruction required, in addition to implementing high quality curricular materials, interactional instructional approaches, intellectually demanding assignments, instruction sensitive to diverse needs of learners, appropriately paced introduction of new concepts and more instructional time for math and science.

At the elementary school level, in addition to the professional development workshops, the district offered some tools to help teachers reflect on and monitor how they were using the CMSI curricula and shaping their instruction. Pacing guidelines were created specifically for the CPS calendar each year so that a teacher at any grade-level could see the pace at which they needed to teach in order to cover the full year’s materials. (For example, see 2008-2009 pacing guides for Math Trailblazers at
More general Classroom Observation Guides were created for math and for science to foster discussion between teachers and others in order to improve instruction. These reflective tools did not refer to specific curricula but instead posed questions about the teacher moves and student moves taking place during classroom lessons. (See 2008-2008 examples of these guides for math and science at http://www.cmsi.cps.k12.il.us/ViewNewsDetails.aspx?pid=81&id=7450 and http://www.cmsi.cps.k12.il.us/ViewNewsDetails.aspx?pid=77&id=6150.) The pacing and classroom guides were created as tools for teachers; they have not been used for collecting data. Therefore the district does not have central data on the extent to which teachers’ instruction mirrors these guidelines.

The extent to which elementary schools complied with the required instructional time needed for math and science is monitored officially through reports each school files with the district and these show that all schools set aside 60 minutes a day for math and 120 minutes per week for science. However, external evaluation found that particularly in middle grades where departmentalization was taking place, the full 60 minutes a day for math was not always met. Time for the students to move from classroom to classroom for specialized math or science or language arts cut into the school day. It was not uncommon for middle grades math classes to only have 50 minutes a day for their lessons.

Even determining if a given CPS elementary school was implementing a given math or science curricula was not a simple matter. In the local control environment of CPS, it took special investigation to determine which schools were purchasing CMSI-supported curricula and then to determine if they had ordered enough materials to appropriately equip classrooms to teach the materials as intended. Teachers’ attendance at curriculum-specific professional development workshops was another way to approximately see where implementation was taking place.

The district commissioned various external evaluation studies to see how curricular materials were being used in elementary schools. One strand of studies looked across the years of 2003 to 2008 to learn about how schools were “implementing.” The schools studied were Intensive Support Schools or those that purchased materials or attended professional development. These studies learned that these schools may or may not be places where teachers had even opened up the boxes in which the curricular materials had been shipped. Those teachers who had opened the boxes may or may not have been using the materials. Those who used the materials may not have been using them everyday. Those using them everyday may not have been using them in the way “proper” according to the authors of the curricula. Even in schools were there were many teachers using the materials regularly with most students, teachers were not using the materials to teach students with disabilities. Teachers’ decisions on how to use curricula were influenced by their beliefs in whether they trusted that the curricula taught as intended would really help their students to master material and perform well on standardized tests and whether the curricula were designed appropriately to meet the specific needs of their students.

iii. Sustainability

[Forthcoming]
Scaled up breadth and depth
[Forthcoming]

New programs and curricula
[Forthcoming]

CLICK HERE TO SEE LIST OF SELECTED ORIGINAL EVALUATION REPORTS RELATED TO THIS TOPIC
b. In-service Professional Development

From the beginning, the CMSI model and vision included a human resource component. The development of human resources took many avenues with a large piece of this being the development of human capital via professional development opportunities for teachers, curriculum specialists, mid-level/district-level math and science leaders, and principals. Through this process of professional development the district was poised to reach a large percent of its math and science personnel.

i. Context

We begin this section with an overview of the literature on professional development. This literature and the district’s decentralized past shaped the districts thinking regarding how to develop and provide professional development. In addition, we consider the context of both state policies regarding teacher certification and endorsement policies and the Chicago Teacher’s Union contract and policies.

Literature

In 2001, the Consortium on Chicago School Research released a report on the state of professional development in the Chicago Public Schools from 1997-1999. This report described a model of effective professional development, evaluated the extent to which the district followed this model, and described the sources, means of delivery, and school-level supports that promoted effective professional development (Smylie, et al, 2001). Based on review of the National Staff Development Council, the National Commission on Teaching and America’s Future, the National Partnership for Excellence and Accountability in Teaching and the National Society for the Study of Teaching’s research on effective professional development should provide content rich material, include frequent guided participation/exposure to the innovation, promote a community/context approach to adult learning and shared experience, and entail a pedagogical method that models the change teachers are being trained to make.

The professional development should be curriculum-focused. Development of curriculum-focused professional development is part of the theory of action of the Local Systemic Change Initiative, which predicts that “teachers, with ongoing support, will be more inclined to change their instruction in ways advocated by national standards, and will have more capacity to do so” (LSC Capstone Report 2006). As stated in Designing Professional Development for Teachers of Science and Mathematics, “In districts around the country, curriculum selection, adoption and implementation are such common practices in science and mathematics that focusing on teachers’ professional learning around the curriculum is a great way to embed within the work of real teachers” (Loucks-Horsley, et al, 2003).

Researchers have found that professional development programs that are one-shot deals or that provide the majority of training experience prior to the start of implementation of a reform are not very effective (McLaughlin, 1978). Therefore, advocates for effective professional development see it “as a process, not an event” (Guskey, 1995, p. 123). This is consistent with other research which indicates that sustained professional development, which is aligned with standards-based curricula, can positively impact student achievement at the school level (Cohen & Hill, 1998; Kannapel & Clements, 2005; Wenglinsky, 2000, 2002).

Curriculum-focused professional development is important in developing a community among new implementers where teachers can report their experiences, implementation issues can be shared, and
teachers can support each other (Ball 1996). The support is important because part of the process of changing instructional practices through professional development includes the creation of cognitive dissonance (Ball and Cohen 1999). Giving teachers the opportunity to reflect with each other about the implementation process at various times during the course of the school year can affect the success of the implementation (Loucks-Horsley, et al., 2003).

Decentralized professional development pre-2002

In the context of “locally controlled” Chicago Public School system, professional development particularly around curricular innovation was a school level endeavor. As part of the 1988 Chicago School Reform Act, schools were charged with developing annual school improvement plans. These plans included providing for the professional development and growth of teachers. However, the success of a schools professional development program depended upon the leadership at the school and their ability to ensure professional development included the core elements discussed above.

To supplement the capacity at individual schools, various external partners began working with schools to provide professional development to teachers. Part of the push to connect to external partners came from within the district. In 1994 recognizing that some schools were not able to improve on their own, the district superintendent named those schools with the most needs as probation schools. As such they were inundated with resources and mandates geared towards helping them make gains in student test scores. In particular, the district assigned external probation managers to work with these low achieving schools. Other influences came from private foundations. In 1990 the MacArthur Foundation and other organizations in Chicago made grants available to external groups to work with schools. Also at this time Ambassador Walter Annenberg announced a $500 million challenge grant to improve public education in the United States. A small group of school reformers, known as the Annenberg Working Group, drafted a plan to bring some of these resources to Chicago. In 1995, the Annenberg Working Group was awarded $49.2 million to improve Chicago schools. As part of the grant agreement, schools were to form networks with at least two other schools and one external partner. These partners often played the role of providing schools with professional development geared towards their school improvement plan (Newmann & Sconzert, 2000; Smylie et al., 2001). However by 2000, it was clear that a lack of capacity to lead schools in their improvement plans existed among the external partners (Newmann & Sconzert, 2000; Smylie & Wenzel, 2003).

In 2001, the district adopted a professional development model that included the creation of an Office of Professional Development. This office was charged was [Forthcoming]

Teacher recertification and endorsement policies

The Illinois State Board revamped teacher certification and endorsement policies based on the State Board’s 1996 report titled “Illinois Framework for Restructuring the Recruitment, Preparation, Licensure, and Continuing Professional Development of Teachers.” The report developed with investigation and advice from ten councils or committees, such as the Council of Chief State School Officers, State Board of Education Professional Development Team, Joint Education Committee of the State Board of Education, the Board of Higher Education, and the National Council for Accreditation of Teacher Education, recommended several major initiatives aimed at better attracting, preparing, and supporting teachers while also making them more accountable.

Those recommendations included creating
- A standards-led teacher preparation and institutional accountability process;
- A multi-tiered certification system;
- Professional development expectations for certificate renewal;
- An induction and mentoring process for novice teachers; and
- Alternative routes to teaching. (see http://www.isbe.net/profprep/PDFs/Framework1996.pdf)

Changes in policies on certification, recertification, and endorsements at both the state and federal level impacted CPS teachers. Thus, we look more closely at the second and third recommendations and how the State Board’s policy affected CPS teachers.19

The Illinois Framework for Restructuring the Recruitment, Preparation, Licensure and Continuing Professional Development of Teachers ( Adopted November 21, 1996 ) promoted a three-tiered system to reflect “the stages in the professional development of teachers and promote their continuing growth as educators—i.e., an Initial License, a Standard License and an Advanced License” (p.8 of http://www.isbe.net/profprep/PDFs/Framework1996.pdf accessed 10/27/08).

The First Tier (Initial License) was issued to a beginning teacher based on evidence that he or she met the basic professional teacher standards:
- Completion of an approved teacher preparation program in IL;
- Licensure by a state with which IL has a reciprocal teacher licensing agreement; or
- A to-be-defined process for evaluating the individual’s professional preparation (e.g. a revised transcript/experience evaluation).

Plus, candidates needed to show successful performance on a State assessment
- Of the subject content
- Of the knowledge and skills essential to the profession of teaching
- Of the application of those skills and content in the classroom.

Second Tier (Standard License) replaced the Initial Teacher License after recipient completed a two-three year new teacher induction program. The Standard License was valid for five years and renewable upon evidence of meeting the requirements for continued professional development.

Third Tier (Advanced Certificate) was available to Standard Teacher License holders who choose to demonstrate their teaching expertise through the process developed by the National Board of Professional Teaching Standards. This license was valid for seven years and, like the Standard License, subject to renewal upon evidence of continuing professional development (http://www.isbe.net/profprep/PDFs/Framework1996.pdf, page 9).

With this change in state policy, for the first time ever, the state began requiring Illinois teachers to complete and show proof of ongoing professional development for certificate renewal. Professional development “credits” could be earned for a wide range of activities completed over the five years covered by a Standard Certificate. To start with, teachers had to complete Certificate Renewal Plans detailing three individual improvement goals and how they planned to meet those goals. The plans

19 We note that these policies that began being enacted in January 2001 changed again after the No Child Left Behind Act was signed into law a year later.
were reviewed, approved and administered by Local Professional Development Committees comprising three teachers, the local superintendent or representative and one other person (http://www.isbe.net/news/2000/dec14-00.htm). Continuing professional development options that would generate credit for the purposes of certificate renewal included the following activities:

- Completion of an advanced degree from a regionally accredited institution in an education-related field
- 8 semester hours of college coursework in an undergraduate or graduate-level program related to education
- National Board certification or recertification
- Receipt of a subsequent Illinois certificate or endorsement
- 24 continuing education units (CEUs)
- 120 CPDUs (1 semester hour of college credit = 15 CPDUs or 3 CEUs; 1 CEU = 5 CPDUs) [this from http://www.isbe.net/rules/archive/pdfs/25ark.pdf]

ii. Vision: Evolution through Enactment and Feedback

In 2003, having chosen 5 standards-based elementary math and science curricula as a foundation for supporting improvement in instruction, the district began providing teachers with a two-year program of professional development workshops.

Coherent policies

The professional development workshops were offered in a grade-specific and curriculum-specific manner. In their first year teachers enrolled in New Users’ professional development which started with a summer week-long intensive and was followed by monthly sessions throughout the year, which added up to approximately 50 hours of professional development during the one year cycle. Then in their second year of using the curricula, the teachers enrolled in Experienced Users’ professional development, which in its earliest inceptions included 40 hours of professional development during the year, to the 2008 level of 15-20 hours per one year cycle (summer plus the following academic year).

For the New User teacher, 50 hours of professional development represented a large investment in time and money. Summer professional development sessions generally consisted of three hours of training everyday for one week, with the intention of providing teachers with enough background and support with the curricula to get them through enough of the curricular materials to cover the first quarter marking period of the school year. Academic year sessions were delivered either during the school day, or on Saturdays. Teachers received a stipend (at a standard reimbursement rate) for the summer sessions and for Saturdays, and their schools received funds to obtain substitute teachers to replace those at school-day professional development. Funding for professional development in most cases came through the Office of Science and Mathematics, although in some cases, the funding was supplemented by state and private funding sources (IBHE, NIEP, CCT). Additional sources of funding for curricular materials for schools and/or professional development have come from private funding sources (NIEP, Polk, Fry).

In the early years of CMSI, adoption of the district-recommended science and mathematics curricula (and attendance at curricula-specific professional development) was not open to any school that desired them. In 2003-2004 approval from OMS was required. In the years following, any school
could opt to use their allocated textbook funds to purchase the materials, or to seek additional funding for their purchase. It was expected that any school that purchased the materials would send the appropriate grade-level teacher to the professional development sessions associated with the curricula. Principals and specialists who attended professional development provided by the OMS were encouraged to have all implementing teachers utilize this support. OMS staff and Area staff were also encouraged to help schools sign up for these professional development sessions.

Attendance at professional development sessions was disappointingly low, although the rates did slowly increase. Monitoring attendance was not a simple undertaking. Registration for math and science professional development sessions originally took place through the Office of Mathematics and Science, but after 2005, all professional development registrations were done through a Chicago Public Schools central system. The online registration process for teachers underwent various procedural changes over the years, and was not always smooth. Many CPS elementary teachers were not very facile with using the internet and email. One factor that made monitoring difficult was that more teachers registered for professional development than ever showed up to a session. This may have been partially due to changes in staffing or teaching assignments that occurred between summer and fall. For example, the table below illustrates the attendance rate trend at SEPUP (the 7/8th grade science curriculum) professional development over the past three years.

Table 11 Attendance rate of participants in SEPUP training

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7th grade</td>
<td>32% (N=128)</td>
<td>46% (N=104)</td>
<td>49% (N=65)</td>
</tr>
<tr>
<td>8th grade</td>
<td>27% (N=78)</td>
<td>41% (N=73)</td>
<td>53% (N=48)</td>
</tr>
<tr>
<td>7-8th grade</td>
<td>31% (N=14)</td>
<td>68% (N=30)</td>
<td>60% (N=49)</td>
</tr>
</tbody>
</table>

The increase in SEPUP professional development attendance seen in the 2006-2007 academic year may have been due to pressure exerted on school principals by the OMS Science Director at the time, Michael Lach. Lach sent a memorandum in September 2006 to all principals advising them that if the appropriate teachers in the school did not attend at least 80% of the SEPUP sessions; their schools would not receive reimbursement from OMS for paying for substitutes for school-day professional development. While attendance rates were still not at 80%, the letter may have served to make principals more aware of whether or not their teachers were attending professional development. It was not the objective, however, just to increase the number of teachers at professional development. In some cases, teachers were sent to be in professional development workshops in anticipation of their school’s purchasing the materials. Since the professional development was completely curriculum-focused, teachers in schools where the materials were not available were not encouraged to attend.

Workforce development

Professional development workshops were delivered through collaborative relationships between universities, curricula publishers and the CPS district. There were various “implementation and support centers” partnering with CPS around various curricula and providing professional development workshops. The configuration of these partnerships changed over time.
Models of support: The example of collaboration around SEPUP implementation

One case of a three-way partnership was exemplified by the implementation of the Science Education for Public Understanding Program (SEPUP) curricula in 7th grade (the Science and Life Issues curriculum) and 8th grade (the Issues Evidence and You curriculum) in CPS schools. The partners were CPS, Lab-Aids (the distributors of SEPUP) and the Loyola University Center for Science and Mathematics Education (LUCSME). The partnership began in 2003 when Michael Lach, then Science Manager at OMS, asked LUCSME to become the “SEPUP Implementation Center.” The characterization of what that entailed was not at all detailed, but developed over time.

In 2003, LUCSME was successful in obtaining funds from the Illinois Board of Higher Education (IBHE) to provide support for efforts with OMS. This grant, starting in the summer of 2004, was renewed annually until 2007, providing a total of $700,000 in funds for support of the SEPUP curriculum used in CPS 7th and 8th grades.

In these first few years of implementing the SEPUP curriculum into CPS classrooms, the primary efforts were focused on training teachers in methodologies of inquiry based science teaching in general, and in particular, applying these methodologies to the SEPUP curriculum.

Since there were essentially no CPS teachers experts in this curriculum, much of the training in the first year was done by staff and consultants of Lab-Aids, the company that markets the SEPUP curriculum, with a core of five Loyola University science faculty providing mentoring and content enhancement to the teachers at all professional development sessions. The funds from IBHE allowed Loyola to pay stipends (for summer and Saturday sessions) or pay for substitute teacher coverage for all the CPS teachers who attended these sessions during the first three years of implementation. The funding also paid for Loyola faculty to participate in this program, and funded the Lab-Aids staff and consultants to travel to Chicago many times each year to take the leadership role in the professional development sessions. Lab-Aids provided the kits to CPS schools at a reduced price, and funding from the Polk Foundation and the Lloyd A. Fry Foundation through LUCSME helped defray the cost of kits to schools.

Over the three years of this grant, the reliance on the external Lab-Aids consultants was reduced by increasing the expertise of the Loyola faculty involved in the project, but more importantly through identifying and training a cohort of CPS teachers who became Professional Development Leaders (PDLs). Candidates for PDL included LUCSME-recommended teachers who had successfully completed LUCSME courses for the science endorsement to be SEPUP PDL, and OMS-recommended experienced users who had been identified during experienced user training. Every candidate for PDL was interviewed, and their classroom pedagogy was observed by OMS staff. PDLs all attended a training session run by OMS staff. In addition PDLs attended a weeklong intensive SEPUP Academy in the summer, which focused on training expert SEPUP users to train other teachers. As the program evolved, Loyola faculty and CPS PDLs took over more and more of the training so that by 2008 there was almost no direct involvement of Lab-Aids staff or consultants, illustrating the breadth and depth of teacher leadership that can contribute to the sustainability of the program.

In the first few cohorts of PDLs, Loyola had the financial responsibility for paying them supplements for their salaries, and Loyola had a significant and (very possibly) primary role in identifying, recruiting, and training (with Lab-Aids staff) teachers to become PDLs. In 2006 - 2008, the financial responsibility for paying them was undertaken by OMS, and as the implementation of SEPUP had spread through CPS, there was each year a larger pool of teachers to draw upon who were
experienced in the program. By 2008 OMS staff had the primary role of identifying, recruiting and training teachers, with Loyola faculty working in advisory and supplementary roles.

As noted above, Loyola’s IBHE grant funded the stipends paid to CPS teachers for attending the professional development workshops for the first three years of implementation. After the first three years of implementation, many school administrators recognized the value of these sorts of scientifically based curricula and the need for intensive and ongoing professional development. Now, each school interested in implementing this curriculum provides funds to pay for teachers’ stipends.

Figure 14 below illustrates the evolution of responsibilities and funding for SEPUP implementation that have occurred over the years. The color of the responsibility corresponds to the partner in the diagram. Mixed responsibilities are denoted by the corresponding secondary colors—for example green denoting when CSME and LAB-AIDS both supported this area.

Figure 14: Responsibilities and funding for supporting SEPUP implementation

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
<th>2005</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>teacher stipends</td>
<td></td>
<td>teacher stipends</td>
<td>teacher stipends</td>
</tr>
<tr>
<td>consultants from Lab-Aids</td>
<td></td>
<td>consultants from Lab-Aids</td>
<td>consultants from Lab-Aids</td>
</tr>
<tr>
<td>faculty content experts</td>
<td></td>
<td>faculty content experts</td>
<td>faculty content experts</td>
</tr>
<tr>
<td>professional development leaders</td>
<td>professional development leaders</td>
<td>professional development leaders</td>
<td></td>
</tr>
</tbody>
</table>

More than 700 teachers from more than 200 (of ~500) elementary schools have participated at some level in the SEPUP training. (See the table below)

Table 12Total number of participants in SEPUP training since 2004

<table>
<thead>
<tr>
<th></th>
<th>Summer 04 &amp; Academic Year 04-05</th>
<th>Summer 05 &amp; Academic Year 05-06</th>
<th>Summer 06 &amp; Academic Year 06-07</th>
<th>Summer 07 &amp; Academic Year 07-08</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of New users</td>
<td>124</td>
<td>220</td>
<td>207</td>
<td>162</td>
<td>713</td>
</tr>
<tr>
<td>No. of Schools (additional each year)</td>
<td>65</td>
<td>83</td>
<td>47</td>
<td>35</td>
<td>230</td>
</tr>
</tbody>
</table>

An important contribution to the institutionalization of SEPUP in Chicago has been the “Chicago-ization” of the SEPUP professional development. Teachers had some concerns about implementation
that were directly a result of specific pressures coming from the district. Firstly, Chicago had a long tradition of having students participate in “Science Fair”. Schools implemented science fair in any way they wished, but the most common trajectory was for schools to have a school science fair in December. A few projects from each elementary school (from grades 7 and 8 only) and from each high school were selected to go to the Area science fair in January. Approximately 15 projects from each Area (18 elementary areas, and 6 high school areas--an area includes approximately 25 schools) were chosen to participate in the citywide science fair in March. The top 50 of these projects go on to the Illinois Junior Academy of Sciences (IJAS) Exposition. Administrators take a great deal of pride in their school’s successful participation in these fairs and in the past, science fair had been the only tangible evidence of hands-on science taking place in schools. This had changed with the advent of CMSI, but some teachers still felt a disproportionate amount of pressure to get their students to participate, and they often stopped regular instruction to “do” science fair. This was problematic on two fronts: 1) in schools using CMSI curricula, this put teachers off the recommended pacing, and 2) many teachers who did this, were not very adept at mentoring students through the process of developing a project, and the project quality at the school fairs was quite low.

A second district-based concern that teachers had which effected implementation was the pressure to improve the standardized test scores, which lead teachers to stop using the curricula sometime in February or March (depending on the testing dates) in order to do ISAT preparation.

The use of homegrown PDLs who were familiar with district and school culture was essential to gain teachers’ trust and buy-in that it was not necessary to stop instruction in order to meet the pressures of science fair and ISAT testing. In the case of science fair, PDLs pointed out to teachers specifically which activities in the curriculum used an open inquiry approach, and could easily be adapted to a science fair project. In the case of ISAT, PDLs emphasized that the science portion of the ISAT (given in 4th and 7th grades) was largely focused on skills and processes of science. The skills highlighted on the ISAT were the same as those highlighted in the curriculum, i.e., how to read and interpret graphs, knowing the flow of the scientific method, being able to read an experiment and pull out the independent/dependent variables, and control and treatment groups. In addition, Lab-Aids provided documentation of the correlation of the SEPUP curricula with the Illinois Learning Standards (http://www.sepup.com/correlations/Illinois%206-8.pdf) which PDLs pointed out to teachers in professional development sessions. The problem of teachers stopping instruction of the curricula to teach ISAT skills decreased over the years of CMSI implementation, perhaps as a result also of the district move towards departmentalization of the middle grades, leading to less pressure on science teachers to prepare their students for the yearly math and reading ISATs. According to Lab-Aids consultants, SEPUP implementation in Chicago had a different look than it did in other urban districts. This was probably due to the close relationship the Chicago implementers had with LUCSME, and with the use of PDLs who had the ability to be flexible enough to address teachers’ locally-based concerns.

New users and experienced users

OMS recognized that one year of curriculum training and support was not sufficient to generate expert users of the designated curricula. However, it was difficult to attract second year users to attend professional development. Attendance at second year professional development was always low--rarely more than fifteen teachers per session. Several attempts were made to determine what the experienced users needed, both from their own perspective (via surveys and focus groups), and from the perspective of district leaders. A common desire of teachers across the curricula was to examine
student work. The SEPUP curriculum recommends the use of its own assessment system, which differs ideologically from the system teachers typically used. Attempts were made to attract teachers to attend experienced professional development through holding sessions at area museums, but this did not have a substantial effect.

**Training the trainers**

In addition to training the teachers using new curricula, the various support staff working with the teachers needed to learn the new curricula as well as learn how to craft their new roles as instructional leaders. Table 13 offers a listing of some of the initial CMSI professional development offerings covering teachers and those training them.

Table 13  2002-2003 selected professional development on use of CMSI-supported elementary school curricula

<table>
<thead>
<tr>
<th>Professional development for</th>
<th>Across this period of time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers implementing CMSI curricula (N=898)</td>
<td>Initial 3- to 5-day session with 60 hours of follow-up sessions</td>
</tr>
<tr>
<td>Teachers at schools that are preparing to implement CMSI curricula in following year (N=~500)</td>
<td>60 hours of sessions across the year</td>
</tr>
<tr>
<td>Principals in schools where curricula implementation taking place (N=78)</td>
<td>Six 3 hour sessions across the year</td>
</tr>
<tr>
<td>OMS instructional staff (N=~25)</td>
<td>Initial 3-month Leadership Academy with periodic follow-up sessions</td>
</tr>
<tr>
<td>Area Math Science Coaches (N=18)</td>
<td>Initial 3-week Institute with weekly follow-up sessions</td>
</tr>
<tr>
<td>School Math Science Specialists (N=78)</td>
<td>Initial 2-week Institute with another week in summer and then bi-monthly follow-up sessions</td>
</tr>
</tbody>
</table>

**IDS**

Each IDS designed their own professional development, and were facilitated in some cases by the curriculum developers, and in other cases by expert users and instructional coaches. An average of 60 hours of PD was provided to first-year teachers, and 30 hours for second-year teachers.

Figure

[Forthcoming figure to show how high schools attending professional development changed year to year]

Improved instruction/aligned with standards-based materials

[Forthcoming on relationship between professional development and ISAT, etc.]

**iii. Sustainability**

Scale: developing internal scheduling and databases

At the start of the CMSI, 81 elementary schools with approximately 10 teachers began implementing one of the four math or four science standards-based curricula. These professional development sessions were not one shot, cursory workshops but rather series of on-going, coordinated sessions beginning in the summer and continuing through the school year and entailed between 30-60 hours of professional development (depending on the year and level of experience).
In the summer of 2003, 898 teachers participated in 18,818 person-hours of curriculum-specific professional development. During the 2004-2005 school year, the implementing schools expanded their numbers from one teacher per grade level to all teachers at all grade levels using the instructional materials. In addition, 279 other district elementary schools began to implement the curricula. Together these schools sent 1,495 teachers to the 30 hours of curriculum-specific professional development (25,415 person-hours). In 2005, 2,345 elementary teachers attended curriculum-specific professional development totaling 34,024 person hours in preparation for implementing district-supported curricular materials (CUSP Annual Report, 2006).

This scaling up had certain implications for the OMS in relation to providing continued on going professional development at grade level. This required both acquisition of CPS space in which to house these sessions and a large number of instructors to provide this professional development. These many sessions were offered at multiple times at multiple sites throughout the city to increase participation by allowing attendees increased convenience of time and location. For example, during the [200x] school year, [xxx] curricula-specific, grade-specific professional development sessions took place. [Forthcoming]% of these sessions took place concurrently, stretching the human resources available to provide this professional development and putting demands on the districts ability to house professional development.

Prior to CMSI, the development of a scheduling system on this scale had not been accomplished before in CPS and the OMS had to coordinate this process with many intermediaries beyond their Office. Some of the issues they faced were as follows:

- Scheduling professional development in connection with the official CPS Calendar
- Securing venues to hold all of the professional development sessions (utilizing local schools, partnering with The Museum of Science and Industry and local universities to house professional development sessions on their sites)
- Developing useable accounting measures to document teacher registration and attendance so correct number of CPDU/CEU could be recorded
- Developing data management systems to schedule sessions, to register teachers, to document attendance such that person-hours could be calculated to accurately account for teachers' time away from their school building, to provide data for paying teachers stipends or for reimbursing schools for substitute teachers.

[Forthcoming more on the use of CPS master scheduling, creating internal data bases on teacher attendance at these meetings]

CLICK HERE TO SEE LIST OF SELECTED ORIGINAL EVALUATION REPORTS RELATED TO THIS TOPIC
c. Human Resources Supports Strategy: Developing and Sustaining Mid-Level Supports for High Quality Math and Science Curriculum Use and Instruction

i. Context: Initial framing and design of the strategy

Literature base

One of the challenges accompanying systemic school reform efforts is that of leveraging, developing, and sustaining the resources (human and material) needed to expand the scale of the reform while building and maintaining a coherent vision and high quality implementation (instruction, professional development, provision of materials, etc). In the literature on systemic reform, this is often referred to in terms of “capacity building.” (see for instance Floden, et al. 1995).

This broadly conceived challenge of capacity building acquires a degree of specificity when the reform effort aims to improve the quality of instruction and learning in particular content areas, as is the case with the CMSI. Because the CMSI proposes to improve teachers’ math/science instruction (as the most direct/immediate causal link in the chain toward improved student learning outcomes) through teachers’ effective (“faithful”) implementation of a limited number of math and science curricular packages, it is perhaps not surprising that district-wide provision of high-quality professional development to teachers would be a key strategic activity in the reform effort. (See previous of this white paper on the CMSI strategy of providing district-wide professional development.) Indeed, there is a growing body of research literature and evaluation studies in math and science education that identify the provision of high-quality professional development20 as contributing to the improvement of teachers’ practice – in particular when that professional development addresses content knowledge and pedagogical content knowledge.

Research has also shown that the impact of professional development on instruction is positively affected when it is sustained over time and when there is follow-up support work that takes place in the schools (Blank et al, 2008). It was perhaps with this research in mind (as well as with the strategic aims described in the next section of this chapter), that the CMSI planners conceived of a strategy of training and employing cadres of “human resource supports” who would reinforce, supplement, and contextualize the learning that would take place during curriculum-driven, district-level professional development, by providing additional support to teachers at the classroom, school, and Area levels.

The purpose of this section is to (a) review the literature that describes successful models for ongoing professional development support to teachers that supplement and/or sustain the knowledge and practice acquired through district-level professional development; (b) identify which model(s) were considered by the framers of the CMSI and why; (c) identify which models were not considered by the CMSI designers and suggest why this might have been. Attempting to determine the basis for selection of certain supports models and not others is germane to this report because it contributes to an understanding of key assumptions underlying the initial vision for this strategy. While we recognize that any reform strategy will have to be selective as it is framed and initially implemented,

20 Numerous studies have also found that much teacher professional development does not meet research-based standards for high quality (Garet, Porter, Desimone, Birman & Yoon 2001; Desimone, Porter, Garet, Yoon & Birman, 2002; Corcoran & Foley, 2003). Components of high-quality, effective professional development are certainly intrinsic to the CMSI model, both for the district-wide professional development and ongoing supports. Whether that high quality has been maintained in practice through the ongoing supports is taken up later in this section.
one of the issues we consider in this chapter is the extent to which the strategy’s underlying assumptions may have been adhered to, even at times when external contextual factors and internal challenges might have suggested a shift in vision and/or assumptions. In subsequent parts of this section we consider how the strategy was actually implemented (“rolled out”) and modified in response to key contextual factors and challenges.

Models for “human resource” supports for improving teaching practices and student learning

As mentioned above (and discussed in the literature overview for this report), numerous studies have identified some common features of professional development programs that have had measurable effects on teachers’ teaching and learning. In addition to mathematics and science content emphasis, these features include a high amount of time for each teacher in professional development per year, the extension of professional development activities over time through the use of mentors or coaches, and a connection between teachers’ professional development to the curriculum and organization of their schools. According to the review of research, this last feature allows for, or supports, the development of “professional learning communities” within the teachers’ schools. Professional learning communities are used by teachers for the purposes of lesson study, reflection on teaching experiences, and/or working in grade-level teams.

At the same time, there is conflicting evidence as to whether the most effective mechanism for providing ongoing professional development support is through teachers as “teacher leaders,” or through dedicated staff, “freed teachers” who take on school-based, multi-school, or district wide roles as “lead teachers,” “coaches,” “mentors,” and the like. Most research and policy studies advocate for the incorporation of teachers as “instructional leaders” or “supports” as a necessary if not sufficient facet of school reform efforts (Conley and Muncey, 1999; Lieberman, 1988; Urbanski and Nickolaou, 1997). One of the underlying assumptions behind this approach is that improved teaching through effective teacher leadership should involve a move away from top-down, hierarchical modes of functioning and a move toward shared decision-making, teamwork, and community building (Alvaredo, 1997; Coyle, 1997). This approach, which is consistent with the identified value of supporting the creation of school-based learning communities through ongoing professional development, may be perceived as having certain risks in relation to reform efforts that have as a key aim the coherence of policies and messages. Another way of thinking about this is that the former is a decentralized approach to supporting improved instruction beyond professional development, where the latter is a centralized approach.

As is discussed in the next section of this chapter, it would seem that as the OMS developed this strategy for CMSI, they were inclined to opt for this latter approach to the provision of ongoing human resource supports to teachers beyond professional development in the curricula. Alternately referred to within OMS/CPS as “facilitators,” “coaches,” “specialists,” or “lead teachers,” these human resource supports are generally also conceived as playing “leadership” roles for the reform effort in the sense that they teach and model CMSI’s approach to high quality math/science instruction, promoting the reform vision and thereby ostensibly building investment in the reform at the level of individual teachers and/or whole schools. It would appear, then, that in the CMSI planners’ effort to address the three aims (discussed below) of coherent policies, workforce capacity, and improved instruction, the decision to create distinct roles for human resource supports that were

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21 Lead teachers is a term that comes from the CPS Magnet Cluster program, and refers to the freed teachers supported by that program; since there are Magnet Cluster lead teachers who interface with OMS/CMSI, we have included them here.
deployed through OMS and well-trained to carry the message of the CMSI was one way in which this strategy could address those three aims.\footnote{It bears noting that we are making a distinction here between two facets of these human resource supports’ roles: their roles as peer mentors in a sense, and their roles as reform leaders. In fact, in CMSI’s development of these roles, leader(ship) seems to integrate these two facets, with the second facet of promoting the form not explicitly identified, at least not in those leadership training programs with which we are familiar.}

Research on the deployment of teacher leaders to act as coaches or mentors within or across schools, offers a range of findings as to the effectiveness of these human resource supports in improving teachers’ instructional practice and effective use of content knowledge in the classroom. Various studies provide inconclusive evidence that the development and use of “teacher leadership” roles consistently promotes improved classroom instructional practice or improvements in student performance (see Wynne 2000). One of the reasons proposed for these uneven impacts may be related to the fact that the individuals generally recruited and trained to take on these leadership roles are thought of as the best teachers. As a result, the development of “instructional leaders” who are “freed” from classroom teaching, while apparently efficient in terms of internally generated capacity building (when compared to the various costs associated with contracting professional development supports with external vendors), can be costly in terms of the overall quality of classroom instruction within schools/districts, and in terms of teachers’ job satisfaction. It is worth noting, in this regard, that the leadership roles developed by the CMSI vary in terms of the extent to which they involve removing the best math/science teachers from the classroom. (For instance, one could compare the role of the in-school specialist with that of the professional development leader (PDL).)

There is a range of models for how teachers can support other teachers in order to improve instructional practice and student outcomes. There is similarly a range of roles, relationships, and functions that are associated with teachers-as-supports, and a range of locations that supporting teachers occupy within a school and school district. One could propose a continuum from models emphasizing minimal role distinction and flat, or egalitarian relations of peer-to-peer supports (focusing for instance on in-school, teacher-driven professional development, the cultivation of professional learning communities among teachers, peer assessment, etc.); to models emphasizing maximum role distinction (some expert teachers are pulled out of classrooms, e.g., in-school specialists, others are pulled out of schools, area coaches; CWSs) and tending toward greater professional hierarchies. Reform efforts that implement the latter also tend to incorporate a “leadership” dimension in the preparation/training of teachers-as-supports. A distinction is made between being an effective classroom teacher and being a “teacher leader,” which in this context refers not to someone who takes a leadership role as a teacher advocate within the school or district (see some of the literature on teacher leadership); but rather to someone who teaches teachers, or supports teachers as teachers. In other words, in the context of these models, teachers-as-supports need to develop expertise as adult educators.

Within the CMSI reform effort, the “middle level supports and leadership” strategy was initially based primarily on a rather hierarchical model of teachers-as-supports… in which those who could be called “expert peers” – teachers identified as having particular kinds of expertise/experience in the content area that is the focus of the initiative -- are pulled out of the classroom in order to provide additional training/support to other teachers. Over time, as CMSI human resource support (“leadership”) roles have been defined, developed, and differentiated, the location of the supports has been diffused across different sites of professional training and development. It will also be important to consider how the development, refinement, and distinction of leadership roles relates to the
typology of schools that are integrated into the reform as it goes to scale. A notable case in point is the development of Citywide Specialists, charged specifically with providing support to probation schools…

The hierarchically based inclusion and diffusion of teachers as instructional leaders with different kinds of roles and statuses/rankings across the district also raises concerns about school and department, or district level “micropolitics” that are potentially produced or reproduced within and through this strategy…. These micropolitics are evidenced through the story of the reform strategy in various ways, such as the varying degrees of investment in, ambivalence, or resistance to the reform process on the parts of different leaders, a variation that may have corresponded with particular roles/positions and where they were situated within the district and in relation to the reform.

The notion of some experienced teachers becoming supports for/leaders of other teachers, is based in a distinction between (a) becoming a more knowledgeable and effective classroom teacher through attendance at professional development sessions and/or university courses – leading perhaps to additional credentials, certification, etc; and (b) becoming a teacher leader through leadership training that focuses on some facets of teacher education (could be seen as working with your peers, or supporting less experienced teachers in the more hierarchical model); and some facets of linking those practices to the particular content area and pedagogical approaches relevant to the content area. Integral to CMSI’s model for the professional development of internal human resource supports as instructional leaders has been the integration of three kinds of skills/knowledge: knowledge about and ability to be an adult educator/professional developer; math/science content knowledge and pedagogical knowledge around math/science instruction; and knowledge about the particular instructional materials/curricula supported by the CMSI….

Role of strategy within the CMSI theory of action

The central goal of the creation of the CPS Office of Math and Science (OMS) was to bring together a team of math and science educators and administrators committed to a coherent vision of instructional delivery, materials, and supports. As discussed in Section 3.a.i. above, the CMSI planners viewed the inclusion of specific strategies for supporting the delivery of instruction through a limited number of formally approved curricular materials as a necessary component for the sustainability of the initiative. One type of support that has been central to the CMSI from its onset is that of ongoing “human resource” supports. In contrast to approaches taken by some other large urban districts [e.g. the Pittsburgh model], CMSI planners recognized that teachers’ learning of content and pedagogy through professional development workshops provided or supported by curriculum developers and/or vendors would not be adequate to the task of sustaining improvements in teachers’ math and science instruction. It would be necessary to extend that support into the schools and classrooms, for [at least] two reasons: (1) to help teachers adapt the new curricular and instructional approaches to their students; and (2) to ensure that consistent and coherent messages about the curricula were reinforced and sustained within the school settings. In a sense, then, these ongoing human supports were conceptualized as bridges connecting curriculum professional development sessions with classroom practice.

The support roles were initially conceptualized by CMSI planners as facilitators, Area coaches, and in-school specialists. During the first year of the initiative, each of these groups was charged with distinct tasks to carry out the mission of the CMSI:
Facilitators were hired as experts in specific CMSI supported curricula to provide general support to Intensive Support schools (see forthcoming section for description of IS schools) and were viewed as curricular point persons for each curriculum.

Area coaches were to act as an interface among OMS, Area offices, and schools. Coaches were charged with supporting math and science offerings in the schools within their individual instructional Areas.

In-school specialists worked in freed positions in each of the schools initially chosen to implement the CMSI. Specialists were to serve as daily, school-based support for teachers in these schools.

As with the other CMSI strategies, the creation of these mid-level support positions was aimed at providing a coherent understanding about the CMSI approach to math and science teaching, building internal workforce capacity, and improving instructional quality. Throughout the remainder of this chapter, the three major aims of the initiative will be referred to as coherent policy, workforce capacity, and improved instruction.

Coherent policy. One way that this strategy worked toward all three of the aforementioned aims was through the placement of support roles at three different levels of the district—Area level, curricular office level (OMS), and school level. Working within each of their respective levels, but with a common language gained through OMS training, human supports could promote coherence by distributing the policy messages of the CMSI to implementers throughout the district with a uniform voice.

Workforce capacity. The provision of supports at the Area, curricular office, and school levels could work toward building internal workforce capacity by creating a network of curriculum and content experts to serve as scaffolding for newer, less experienced participants in the initiative, and by institutionalizing the CMSI approach throughout the system as a foundation upon which scale-up could occur without diluting the vision.

Improved instruction. With a major emphasis on curriculum as a vehicle for content knowledge and pedagogy improvement, the success of the CMSI depended heavily on curriculum professional development. However, in order to improve instructional quality, curriculum PD must be translated into teaching practice. The ongoing human resource support strategy was intended to serve as the link between PD learning and classroom practice.

Some contextual factors affecting the strategy’s design

The CMSI had to address a number of contextual challenges in designing a human resource supports strategy to support the aims of coherence, workforce development, and improved instruction. Some of these challenges emerged from contextual factors inherent in the Chicago Public School system that initiative planners could foresee in the planning of the CMSI, while others emerged from within and outside of the system after the initiative launched. This section focuses on challenges inherent in CPS as the initiative was designed.

One factor the strategy had to work within from its inception was the reality of a very large school district with limited monetary resources available for math and science education. Support needed to be provided to a large number of disparate schools with a limited number of “humans” to provide the support. This factor was addressed through one of the overarching philosophies of the initiative. Specifically, the CMSI—including its ongoing human resource supports strategy—would be introduced into the system in purposive phases. By this method, a small set of schools would receive...
intensive support in the first year (Intensive Support, or IS, schools), while another small set of schools would receive less intensive support early on, in order to ready them for intensive support in the future (Readiness schools). Through this phase-in approach the initiative maximized its limited monetary resources by devoting the bulk of its human resource support funds to placing an in-school specialist in each of the IS schools. A smaller allocation of resources was devoted to the hiring of facilitators who would support specialists in IS schools and Area coaches who would support all other schools. The initial vision of OMS leaders was that over time a large portion of these personnel costs could be shifted to individual schools who would be willing to invest their discretionary funds to do so after seeing the usefulness of these supports. That is how it would be sustainable because the district knew from the literacy initiative that this model of central human support would not be viable long term.

Another major contextual factor facing the CMSI was that a wide variety of curricular materials were in use throughout the district at the time the initiative was created. Given the array of math and science curricula and materials within schools, curricular expertise was not centered on any particular curriculum or set of curricula. With the initiative’s focus on supporting the use of a select group of research-based curricula, the varied nature of curricular expertise within the system presented a challenge to the CMSI’s support of recommended curricula. To address this contextual factor, planners of the initiative hired facilitators, a group of individuals from throughout the Chicago math and science education community to serve as OMS based curriculum experts. Again, working within the constraints of limited monetary resources, CMSI planners selected one facilitator per recommended curriculum.

A third contextual factor involved CPS’s decentralized system whereby the district curriculum office does not directly manage individual schools. Rather, groups of schools, known as Areas, are managed via an Area office with each school also having a local governing body known as a Local School Council (LSC). Such decentralization presented a challenge to the human resource supports strategy in terms of how OMS, which was housed in the district office, could provide management level supports to all schools. This issue was addressed by a partnership in which the 18 CPS Area offices would staff and fund a cadre of math and science coaches, or Area coaches, who would be deployed by OMS to serve as supports for the CMSI within each Area.

### ii. Enacting the vision: The original strategy in action

During the 2003-2004 school year, the CMSI implemented its constellation of strategies, and the individuals inhabiting ongoing support roles put their envisioned roles into practice. In this inaugural year, the strategy experienced both successes and challenges in working toward the aims of coherent policy, increased workforce capacity, and improved instructional quality.

**Curricular expertise a major asset.**

A major success of the initial implementation of the CMSI came in the form of the curricular expertise of facilitators. These individuals, hired to serve as experts in the CMSI-supported curricula, were viewed among OMS players as true assets to the initiative. One year into the initiative OMS staff and facilitators themselves reported that the math facilitators’ roles as curricular experts could be seen as a major success. One senior OMS administrator said, “These people are more knowledgeable in Everyday Math and Trailblazers and CMP and Math Thematics than anyone in the city.” Major strengths of the work done by science facilitators, as reported both by OMS senior staff and by facilitators themselves were excellent coordination and cooperation among science facilitators.
as well as strong mentoring and leadership in schools. One Lead Team member noted, “we are lucky that we have a group of Science people who make teachers and specialists comfortable in the learning process.” In this way, the vision of creating a curriculum expertise “scaffold” within OMS was a successful support to the pillar of workforce development.

**Lack of a clear CMSI message.**

Throughout the first year of implementation, it became apparent that facilitators and Area coaches were experiencing challenges in their charge to maintain and promote a clear, consistent, and coherent message throughout the district. A major concern for coaches was that of what messages they were to convey across the Areas with respect to current and future CMSI goals. A 2004 external evaluation report indicated a number of coaches’ questions with regard to this issue, including:

- What is the longer-term plan for current broad support schools? What will happen in these schools if CMSI is successful?
- What is the plan in terms of how coaches use CMSI selected curricula in their work with schools? Are they to encourage the use of standards-based curriculum exclusively? How much expertise should they have in the CMSI selected curricula?

Math and science facilitators experienced different issues with coherence during this time. A prominent feature of the first implementation year of the CMSI for math facilitators was frustration at a lack of cohesive management and direction. Much of this situation was associated with personnel gaps within the OMS at large and the appointment of the Strategic Planner as the Elementary Math Manager—an appointment that was intended to be temporary, but was never changed. Science facilitators felt that the CMSI’s policy directives regarding science were inconsistent, and lacked sufficient emphasis on the subject. While this situation was partially attributable to messages within OMS, much of the lack of science prioritization could be traced to the district-wide stressing of literacy and math over science. Thus, the contextual factor of district policies became an intervening factor in some facilitators’ ability to promote the messages of the CMSI.

**The challenge of role ambiguity.**

One issue that emerged very early on in the initiative, and that has implications for all three major aims of the initiative, was the lack of clear role definitions within OMS as well as the district as a whole. In the envisioning of facilitator and Area coach roles, initiative planners made the intentional decision to provide a great deal of latitude, which they saw as freedom, with respect to these roles. Their hope was that these human supports would use this as an opportunity to define their own roles creatively. However, while some facilitators and Area coaches did seem to embrace the openness of their role definitions, most were adamant about role ambiguity as a concern. From the start facilitators expressed their discomfort with what they called an “ill-defined” job role, and coaches echoed this sentiment. One coach explained that there “must be a plan in somebody’s head about what the Coaches’ job was but this plan was not clear to the coaches.”

Although specialists too mentioned role definition as an issue, they were less likely to report it as a major concern. A 2004 specialist report referenced “clarity of job description” as a concern mentioned by specialists, but this issue was not the main concern addressed in the report. The report goes on to say, “… it is important to note that [OMS staff’s] verbal description of the specialist’s role did not appear in writing—neither in the application guidebook distributed to Intensive Support applicants nor in the Intensive Support application.” Thus, it appears that the level of role ambiguity
present in the specialist position caused less discomfort for these individuals than similar ambiguity did for facilitators and coaches.

Loose definitions and confusion over job responsibilities and role expectations can be problematic at both the individual and group levels. Individually, without a documented set of activities and expectations upon which to base their work, both coaches and facilitators had to undergo an extensive period of sense-making with respect to their new jobs. While a period of sense-making is expected in any new role, the level of ambiguity of the facilitator and coach positions seemed to have created a situation in which these individuals had too many choices. Thus, this situation challenged the development of the human resource support workforce itself. That is, coaches and facilitators were having difficulty in determining what exactly their roles were meant to be, let alone how they could develop professionally.

At the group level, this role ambiguity may have had an adverse effect on relationships among the groups’ role of support. For example, from the perspective of coaches, facilitators were at times “missing in action.” Many coaches felt that facilitators were not available or helpful enough to schools and/or to them in their work. Without clear definitions of roles understood by those inhabiting the roles, it stands to reason that individuals would also be without a consistent understanding of the roles of others. Thus, if coaches did not have a clear vision of what they should expect of themselves, let alone what they could expect from facilitators, the occurrence of frustration and confusion within the relationship is not altogether surprising. This discontinuity in different players’ understanding of one another’s roles challenged the goal of coherent policies by creating a lack of coherence within OMS that could have trickled into the deployment of the CMSI.

Finally, as facilitators and coaches struggled to make sense of their roles, they expressed their discomfort with this ambiguity to OMS senior staff. While there were specific examples of times when senior staff were responsive to these concerns, role ambiguity continued to be an issue for facilitators and coaches. It stands to reason that the persistence of this issue within the CMSI may have eroded support personnel trust in their managers’ ability and willingness to address their most pressing concerns. Such an erosion of trust may have spilled over into coaches’ concerns over their lack of understanding of the future of CMSI. It seems that they didn’t have confidence that the OMS senior staff would allow them to be privy to the whole picture in order to communicate the vision to their schools. Thus, this issue challenged human support capacity to serve as ambassadors for coherent policies, workforce development, and, by extension, improved instruction.

iii. Sustaining supports: Responding to external forces via changes in roles

Near the conclusion of the CMSI’s initial implementation year, CPS announced district policies that would have a major impact on the initiative as it was originally envisioned. As a result, the CMSI human resource support strategy had to be adjusted accordingly. Early in 2004, pressures from the No Child Left Behind Act (NCLB) accountability policies resulted in significant changes to the CMSI. The system standard of probationary status changed from 15% (1996) to 20% (1998) to 40% (2004) of students meeting or exceeding state standards. In 2004, 166 elementary schools (roughly 40% of elementary schools in the system) were placed on probation for failure to reach the 40% mark, or Adequate Yearly Progress in mathematics as described by NCLB. The central district and Area offices provided these probation schools with stronger guidelines on their focus and budgeting. In the process, between 50-100 probation schools were mandated by Area offices to adopt CMSI math and/or science materials.
In early March 2004 OMS adjusted the CMSI plan to include these mandatory adoption probation schools. The inclusion of probation schools into the CMSI plan dramatically altered the OMS vision, initially aimed to support an “opt-in” plan where schools would voluntarily choose to implement the CMSI curricula. In addition to district changes to probation school policies, it substantially cut funding for the CMSI. Charged with providing some type of support for a much larger number of schools implementing CMSI curricula with even fewer funds, the initiative was forced to alter its vision for ongoing human resource supports. In doing so, both successes and challenges emerged.

Adapting and creating roles

Over time, the role definition and structural location of the initial human resource support groups changed, in response to a range of contextual factors. For instance, the Facilitator role changed in response to such factors as the expansion of professional development to more and more teachers and provision of support to more schools across the district. Initially the Facilitator provided direct support to Intensive Support schools. Later their role became primarily concerned with leading professional development. Most recently, the facilitators have been charged with training and supporting professional development leaders (PDL) whose provision of PD they will mentor and supervise (see PD section for more information on the PDL role).

Meanwhile, the Area Coach, while initially paid for by OMS had joint reporting to and duties for OMS and the Area offices. The Area Coach role, which was initially overseen by OMS, gradually came to be almost entirely under the purview of the Area offices. These duties often conflicted, as the Area stressed supporting all schools, while OMS stressed provision of support to Broad support and Readiness schools.

In-School Specialists, originally a position paid for by OMS were either taken over by some schools (included into the school budget) or cut from other schools when CMSI funding was cut by the district. Some schools continue to support in-school math and/or science specialists, while other schools support math or science “coordinators” who may or may not be freed from the classroom.

As the CMSI expanded over time to serve a larger pool of schools, while at the same time experiencing budgetary constraints and shifts in the availability of and strings tied to different sources of funding, resources for some support roles were eliminated or shifted to schools, while other support roles were created. Specifically, Citywide Math and Science Specialists (CWS), and Professional Development Leaders (PDL) were introduced:

- **Citywide Math and Science Specialists** were first hired in 2005-06 in response to a growing demand for CMSI approved curriculum support in an expanding number of schools—in particular, in response to the mandated use of CMSI curricula by probation schools. CWS’s were charged with supporting math and science instruction within 4 schools apiece, chosen by OMS and the AIO’s.

Adaptation and creation of roles have both allowed CMSI to continue toward, and challenged its progress toward the goals of coherent policy, workforce development, and improved instruction. Adaptation of the facilitator role has been one way that the initiative has successfully continued toward its goals while responding to external forces. By maintaining a focus on a clearly fruitful component of the original vision—that of the facilitator as curriculum expert—CMSI has provided a stable and coherent “go to” position for those wishing to learn more about specific curricula. This aids the development of both workforce capacity and improved instruction by keeping one portion of the “scaffolding” in place, while at the same time responding to the demands of the growing number of schools who have adopted CMSI curricula. In a similar vein, the creation of the citywide specialist...
position has been a way in which CMSI has stayed true to its vision of targeting a small number of schools in order to implement research based curricula. Citywide specialists, although they rove among approximately four schools, have a finite number of teachers with which to work. This allows CMSI human resource supports to directly support workforce development and improved instruction by working directly in classrooms from a coherent CMSI model.

The adaptation and creation of roles have also posed challenges to the three main goals of the CMSI. One such challenge emerged from the necessity of shifting funding/staffing of roles from within to outside of OMS. For example, the housing of the Area coach position entirely within the Area offices, creates a situation in which these human resource supports have less access to the daily workings of the CMSI. In addition, the in-school specialist role, no longer funded by OMS, is defined differently in different schools. One result of these role adaptations is a fragmenting of the group of individuals charged with providing human resource support to implementers of CMSI curricula. Such fragmenting could challenge the initiative’s goal of promoting coherent policy throughout the district by creating looser connections with more room for inconsistency. The goal of workforce development is likewise challenged by these role changes in that OMS becomes less and less a “hub” for the three arms of support (curriculum office level, Area level, and school level), and the “scaffolding” of supports becomes less centered.

CLICK HERE TO SEE LIST OF SELECTED ORIGINAL EVALUATION REPORTS RELATED TO THIS TOPIC
d. Content Knowledge Depth in Math and Science for Teachers

i. Context

Efforts in Chicago to support teachers in developing content knowledge depth in math and science has been shaped by Chicago Public Schools administrators and teachers and university-based partners who have been

- attentive to the research literature on math and science teaching and learning
- proactive in planning for dealing with federal No Child Left Behind policies around assuring Highly Qualified teachers
- aware of and savvy in seeking funding, and
- willing to trust each other and work across the district and university divide.

Research literature

Across the professional community of math and science educators and educational researchers, there is a view that K-12 teachers need a stronger background in math and science content in order to help their students achieve in these subjects. Various sources support this view. Here we offer a glimpse into the research literature that sheds insights on

- Do teachers’ math and science content understanding influence students learning
- What types of content understanding do teachers need to influence student learning
- What are the characteristics of professional development that foster teacher content learning
- What are the characteristics of strong district-university partnerships given the university role in this work

A review of 25 math and science professional development programs concluded that strong math and science content emphasis (and not just focus on pedagogical practices) was a common feature shared by programs that had positive effects on student learning (Blank, et al., 2008). Research on teachers’ math knowledge reinforces this finding. Hill, Rowan, and Ball (2005) found in their multi-method longitudinal and large scale study that teachers’ mathematical knowledge does relate to increased student achievement in elementary school math. At the high school level, in their study of teachers in North Carolina, Clotfelter, Ladd and Vigdor (2007) found that being certified in math (a proxy for having adequate math content knowledge) related to increased student achievement in math by a statistically significant degree. Interestingly, they did not find that a teacher’s certification in biology had a comparable relationship with their students’ achievement in biology (p. 26). However studies have demonstrated a positive relationship between subject matter knowledge in science and good teaching practice. These studies involve pre-and in-service teachers who teach at a number of grade levels. The studies varied as to how the teacher knowledge and teaching effectiveness were measured, but in general, high levels of subject matter knowledge was positively correlated with teaching practices such as the use of hands-on and laboratory activities, decreased dependence on texts, better ability to plan and carry out lessons and higher comfort levels with facilitating student discussions (Abell, pp.1119-1120 in Lederman 2007).

Merely increasing content knowledge is not helpful if the content is not connected to the experience of teaching. Teachers need to learn content in ways that are connected to the classroom (Cohen & Hill, 1999). In Abell’s extensive review of the research on science teacher knowledge, we are
reminded of the many kinds of science teacher knowledge identified in the literature, as depicted in the figure below. The central type of teacher knowledge in this model is pedagogical content knowledge or PCK, a term introduced by Shulman in 1986. In the years that followed Shulman’s introduction of this term it has been studied by a number of researchers, but there is no complete consensus as to what constitutes PCK. The figure below is a model which posits five components of PCK, and shows the relationship between PCK and other kinds of knowledge for teaching. Most researchers do agree that PCK must contain an understanding of students’ prior conceptions in science (Knowledge of Science Learners), as it is only through the knowledge that students come into the classroom with these conceptions and is not a “blank slate” that a teacher can help a student move forward in their understanding. Key components of the ability of teachers to apply subject matter knowledge to their classrooms are Knowledge of Curriculum and Knowledge of Science Instructional Strategies.
Figure 15. A model of science teacher knowledge (modified from Grossman, 1990 and Magnusson, Krajcik, & Borko, 1999).
Some studies have investigated what types of learning experiences foster teachers learning of math and science content knowledge. In a recent study, the Council of Chief State School Officers (CCSSO) point to some common features of professional development programs that had measurable effects on teachers’ teaching and learning. In addition to mathematics and science content emphasis, these features include a high amount of time for each teacher in professional development per year, the use of mentors or coaches as part of the professional development activities, and a connection between teachers’ professional development to the curriculum and organization of their schools. This allowed for development of a professional learning community within the teachers’ schools, for the purposes of lesson study, reflection on teaching experiences and working in grade-level teams.

Immersion programs have also been found to be effective professional development strategies. These programs may be more oriented to immersion in the processes of science and mathematics (ie, inquiry and problem-solving), or immersion in the world of scientists and mathematicians through participation in research studies (Loucks-Horsley, et al, 2003). These experiences are oriented to the goal of understanding how students learn science and mathematics and in giving teachers the time to engage in firsthand learning of what they are expected to do in their classrooms. These intensive learning experiences must be given time, and cannot be accomplished in short workshop settings. In addition, immersion in science and mathematics content through an authentic research experience can develop deep content understanding and follow-up sessions can help the teacher translate these experiences to their classrooms. (PROMYS program, TRAC program).

Universities have been the site of most efforts focused on professional development regarding math science content knowledge. For example, funding programs at the National Science Foundation, US Department of Education and many state agencies now require school-university partnerships when they make some grants. There have been some empirical studies on how these educational partnerships work. However, while these studies offer some information about features that shape the work of partnership, this body of research lacks clear definitions of partnerships and lacks rigorous research designs on their functioning. Still, findings do suggest the importance of the following features to the health of K-20 partnerships:

- Leadership will
- Shared purpose or problem
- Open communication
- Established governance structure
- Adequate resources
- Trust and respect among partners (Clifford & Millar, 2007).

Supply and distribution of endorsed math and science teachers

On a national level, during the 1990s, the overall picture of teacher qualification levels remained static so that in 2000 only two-thirds of grade 7 to 12 math and science classrooms were taught by teachers with certification or majors in those fields (Blank, 2003). The qualification levels within states vary widely but content knowledge, typically shown by completion of a certain number of math or science university courses is a part of the requirements. In 2000, 73% of grade 7 – 12 teachers in Illinois whose main or secondary assignment was math had a major or minor in math with regular certification to teach their grade level. Similarly 76% of grade 7 – 12 teachers in Illinois whose main or secondary assignment was science had a major or minor in science with regular
certification to teach their grade level. In both cases, Illinois schools fared slightly better than the United States average where 70% and 68% respectively were qualified to teach math and science (Blank, 2003). Within states, distribution of math and science teachers is uneven as students with lower socioeconomic status are more likely to be taught by under-prepared teachers. Geography, salary, and working conditions influence teacher recruitment and retention. Type of teacher preparation also impacts retention with short-term certification programs suffering lower retention after 3 years than regular 4 and 5 year teaching programs (Darling-Hammonds & Sykes, 2003).

The No Child Left Behind (NCLB) Act of 2001 aimed to provide, among other things, the federal incentives and mandates for states and their school districts to work to improve the quality of teachers, especially those in the most difficult to staff schools. In the 2002-2003 school year when NCLB took effect, the law required all teachers in Title I programs or receiving Title I funds to have a full certificate, have a bachelor’s degree, and demonstrate competence in every core subject they taught.23 These teachers would then meet the definition of “Highly Qualified.” All teachers of core academic subjects in public elementary and secondary schools must meet the Highly Qualified requirement by the end of the 2005-2006 school year.

In Chicago Public Schools, in 2002-03, the following percentage of teachers met NCLB Highly Qualified standards:

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Grades 1-5 General Education</td>
<td>93%</td>
</tr>
<tr>
<td>Middle Grades (6-8) Mathematics</td>
<td>53%</td>
</tr>
<tr>
<td>Middle Grades (6-8) Science</td>
<td>60%</td>
</tr>
<tr>
<td>High School Mathematics</td>
<td>88%</td>
</tr>
<tr>
<td>High School Science</td>
<td>81%</td>
</tr>
</tbody>
</table>

The shortage of qualified high school science teachers varies by discipline with the largest needs for teachers in physics and earth/space science but with considerable needs in chemistry and biology as well. By far, the middle grades math and science classrooms in this district faced the highest proportion of teachers needing to work to meet NCLB standards.

Funding availability

In Chicago, funding streams and university-based mathematics and science expertise came together beginning in 2000. In January 2000, the Chicago Public Schools (CPS) received a five-year National Science Foundation Urban System Program grant to improve math and science education. Among the initiatives included in the grant proposal was a partnership between CPS, Northwestern University and others to develop and pilot university math and science courses for K-8 teachers. These courses were designed to improve teachers’ content knowledge of math and science, pedagogical skills for teaching these subjects and understanding of how students learn. Between January 2000 and summer 2003 university partners and the district piloted these courses on a limited scale. Tuition for teachers taking these courses came from the NSF grant.

Beginning in 2004, additional external funding for teaching and tuition of these courses came from state sources. State of Illinois No Child Left Behind grants supported teachers taking UIC math courses. State of Illinois Math Science Partnership grants funded the district’s Algebra Initiative and the courses teachers took at UIC, University of Chicago and DePaul University. State funding also

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23 Core subjects included English, reading or language arts, mathematics, science, foreign languages, civics and government, economics, arts (music and art), history, and geography.
supported teachers taking courses in programs at Loyola in middle grades science, University of Chicago in middle grades math, and DePaul in high school math.

DePaul University and Loyola University used their grants from the Illinois State Board of Education (ISBE) to leverage their creation of master’s degrees in science education. By 2007, the ISBE had altered their math and science grant program to require all grantees to create master’s degrees for either elementary school or high school teachers of math and science. By spring 2008, 24 master’s degree programs in math and science from universities from across the state had planning grants from ISBE. Five of these planning grants went to universities in Chicago who were partnering with CPS: DePaul University, Illinois Institute of Technology, and Loyola University.

Funding from private sources has also has provided tuition dollars for teachers in these programs. BP America funds paid for tuition of teachers in Loyola’s middle grades science program. Polk Brothers Foundation supported math and science middle grades teachers in a University of Chicago program. In 2006, CPS also received grant funding from the Chicago Community Trust and the McDougal Foundation for a project to improve education in middle grades. One facet of that initiative was to fund middle grades teachers taking the approved university-programs that were routes to getting their middle grades endorsements in math and science.

University interest and capacity

On a limited scale, faculty from many universities worked with CPS on the Chicago Urban Systemic Programs (CUSP) development and piloting of math and science courses beginning in 2000. In 2003, the work on these courses was ratcheted up to a district scale. University stakeholders responded to the call for their increased participation in this part of Chicago’s systemic reform effort.

On March 7, 2003 a city-wide “University Partners” meeting was hosted by the newly created CPS Office of Math and Science (OMS) at Loyola University’s downtown campus. This meeting, hosted by OMS Chief Officer Marty Gartzman, had the agenda of encouraging universities to work in more involved ways with CPS to support teacher content knowledge development with math and science courses. At this meeting, Gartzman gave universities early notice that the district would soon launch a new effort to support universities programs for teachers rather than individual courses. He sought feedback on this effort from the meeting attendees.

Gartzman framed the need for these university courses related to the No Child Left Behind requirements that teachers be “highly qualified” in their areas of teaching—and the reality that many teachers in Chicago needed to enhance their credentials in math and science. He noted that it made sense to partner with local universities for providing additional math and science credentials especially given that 75% of current CPS teachers have degrees from one of 11 local universities. In addition, he acknowledged that universities may be wary of working with CPS given that in the past, as Gartzman noted on his presentation slides, “Partnerships with CPS have too-often been “high maintenance” and unreliable” and “Strong partnerships must acknowledge and address needs of universities as well as CPS” which past collaborations had not done as well as they could have. Gartzman talked about the desire of OMS to address these issues and to set up administrative structures to work well with universities.

The meeting was attended by 67 representatives of 14 local universities and colleges. Many questions were asked by university representatives and then answered by OMS. For example, a participant from one of the colleges asked “How close should courses be to CUSP prototype courses?” OMS encouraged faculty to look at the prototypes. Another participant asked if universities
could work together on programs? OMS said they were open to ideas but believed the best programs needed to have cohorts of teachers moving through courses together. OMS also noted that courses needed to be offered at the graduate level and be taught by regular faculty – not adjunct faculty.

On May 1, 2003, OMS formally invited university applications for CMSI approval of university math and science endorsement programs for teachers. Programs with CMSI approval would be able to enroll CPS teachers who would receive tuition subsidies and the university program would receive from OMS “considerable assistance with administrative tasks and recruitment of participants.” The invitation letter from the district described how Grades 6-8 Endorsement Programs were sought and that these needed to fulfill all State of Illinois middle grades math or science endorsement requirements. In addition, it also described a Grades K-5 Mathematics Certification Enhancement Program and a Grades K-5 Science Certification Enhancement Program, both allowing teachers to become “CPS credentialed” in these content areas.

A quick response by six universities led to more than a dozen programs for teachers of math and science approved for the 2003-2004 school year. University participation in this initiative has remained relatively consistent with six universities actively offering math and science programs for teachers in 2008.

ii. Vision: Envisioning through Enactment

The Chicago system of university-based math and science courses for teachers has gone through different phases 2000 to 2008. We explore next how the initiative—as initially envisioned, as scaled up, and as sustained—has related to the overarching themes of Chicago systemic math and science education reform. In what ways has Chicago created policies that are coherent with national and state policies and internally aligned? In what ways has the targeted workforce been developed successfully and in what ways have some groups not been well served? How have university programs for teachers of math and science improved instruction for K-12 students—and what challenges to this goal still need attention?

Coherent policies

In 2003, the Chicago Public Schools Office of Math and Science began offering teachers tuition funding and encouraged them to enroll in approved programs of study around the math and science areas in which they taught. The district was motivated by No Child Left Behind legislation that required all teachers to be “Highly Qualified” in the content area they taught by 2005-2006. The central premise of CPS’ policy was that teachers take approved university programs that, when completed, would allow them to apply for State of Illinois endorsement credentials that would then satisfy national standards for Highly Qualified status. Interestingly, the relationship between CPS program completion, State endorsement, and High Qualified status is not perfectly correlated as evidenced by some of the dialogue at the district level in 2007-2008. District leaders have expressed concern that some teachers who complete the university programs have not been approved for State endorsements. Further, district leaders shared that they have engaged in dialogue with state and federal officials because it has not been clear whether state endorsed teachers are automatically “Highly Qualified.” That issue was cleared up by the end of the 2007-2008 school year and teachers with the state endorsement in middle grades math or science and who have passed their basic skills test are “Highly Qualified.”
In addition, district leaders have become concerned that some teachers who complete the approved math or science programs with CPS tuition support are not then applying to the state for their middle grades endorsement. Understanding the extent to which this does or does not happen has not been possible given the disconnections in how records have been kept in this system. Universities have tracked how teachers perform in their courses. CPS has tracked if teachers are enrolled in approved university programs and courses so that tuition payments are made. The state keeps records of who applied and was granted endorsement credentials. The communication across these organizations on these data had not been systematized as of 2008. During 2007-2008, the district was making efforts to better track these data.

Even given the federal mandates that teachers be “Highly Qualified,” school-by-school compliance within CPS has been challenging to track. Several contextual issues have contributed to this complexity. First, CPS schools are locally controlled at the building level and local school councils appoint principals who have the authority to assign teachers to classes and at the elementary school level (K-8 in most CPS schools) to determine if grades were departmentalized by content subjects or self contained with one teacher teaching all subjects. Teachers in self contained classrooms were not required by NCLB or state or district rules to have special qualifications to teach math or science. However teachers who were departmentalized and teaching specific subjects were required to be endorsed.

However, enforcing whether departmentalized teachers had required credentials was not easy. At the district level, there are not records of whether or not elementary schools are departmentalizing or if teachers are working as a subject-specific teacher at their school. In addition, up until 2007 – 2008, there were no requirements that teachers must be qualified to teach algebra courses to elementary students to prepare them for trying to test out of high school algebra.

Beginning in 2008-2009, CPS will begin mandating that elementary school principals report if new teacher hires are middle grades teachers. If so, these teachers must be endorsed in a content area with the middle grades staff spread across language arts, math, natural science and social science endorsements. Both district and university leaders expressed interest as to how this new Specialization policy will play out over time.

At another level, efforts to use these university courses and programs to foster teacher content knowledge in math and science depends on what is taught and how it is taught within these university courses. There has been no district measure of what teachers learn in these courses. In fact, district records of the grades teachers earn in these courses have been inconsistently documented. District leaders have expressed concern that some teachers may have failed or stopped attending university courses and still have triggered district tuition payment to the university. In 2007-2008 the district began collecting grades in a more systematic fashion.

Workforce development
The CPS effort to offer teachers the opportunity to take math and science content courses at universities for free or little cost began in 2001-2002 with a handful (n=8) of pilot courses each serving from 8 to 15 volunteer teachers receiving full tuition assistance to a full-blown initiative involving 10 universities, seven different types of programs, and enrolling an estimated 500 new teachers annually. Between 2001 and 2008, CPS and university partners helped more than one thousand teachers enroll in hundreds of math and science courses specially created and taught for
their benefit. In total the district has spent over $x in helping defray the costs for district teachers to gain endorsements in mathematics and science.

The largest part of this initiative centers on middle grades mathematics—understandably given this is the area where CPS has the greatest shortfall of qualified teachers and that at these grade levels specific content knowledge becomes increasingly important. Considering teacher enrollments in approved university courses from 2001-2006, 73% of the enrollments were in middle grades math programs. Most of these teachers (over 3 of every 4) took their middle grades math courses at the University of Chicago. However, six other universities also served teachers in middle grades math programs.

Based on data available as of January 2007, of the 3725 enrollments between 2003 and 2006 in middle grades math courses 141 teachers gained their State of Illinois middle grades math endorsement between 2003 and 2006. To better understand the small percentage of enrolled teachers gaining endorsement (4%), future work will match enrollments and attained endorsements at the individual teacher level so as to investigate the paths these teachers took to gaining endorsement between 2001 and 2008. It adds perspective to note that within all of the Chicago Public Schools (including ~18,000 elementary level teachers), just 259 elementary teachers total gained math endorsements between 2003 and 2006 and 62% of these teachers took at least one university class subsidized by OMS between 2001 and 2006.

In 2008, CPS estimated that at least 100 additional math and 50 additional science middle grades endorsed teachers were needed for schools to comply with the minimal requirements of the new district Specialization policy for assuring that middle grades are staffed by credentialed teachers.

Since the initial 2001-2003 design and piloting of CUSP math and science courses for elementary and middle grades teachers, faculty teaching these courses spoke of the struggle they had with teachers varied preparation in math and science and with the judgment as to how to make the courses “college-level” and “graduate” math and science courses. Faculty who designed and taught these courses were respectful of teachers enrolled even if their math or science skills were not strong. Some faculty spoke about treating the teachers with “dignity” and working with them to “reconstruct themselves as learners” of the content fundamentals. Some chose to not grade homework and give tests so that teachers would be “happy and relaxed” and learn more that way. Other faculty expressed “dismay” that even when they adapted their course to address teachers’ content knowledge that some teachers complained about doing homework and did not do “college-level” work.

Faculty perspectives on this topic were consistent when comparing views from 2003 and 2004 with views from 2007 and 2008. Compared to 2004, by 2007 the teachers in these university courses were more likely to be attending due to pressures to gain endorsement in order to keep their jobs rather than an intrinsic interest in teaching better math or science. These teachers appeared to some instructors to need more supports to be successful in the courses. CPS OMS staff and representatives of the university partners have discussed in 2007 and 2008 some of the different ways to consider working better with the wide range of teacher preparation in math and science. They are considering entrance tests prior to acceptance into CMSI-supported programs, remedial courses available to teachers who need additional preparation, and better clarity provided to teachers as to the prerequisite knowledge needed to succeed in each course.

While the improvement of teacher content knowledge is a very prominent feature of efforts in Chicago to reform math and science K-12 education, it has been elusive in terms of measuring and documenting. Neither during the earlier 2000-2003 CUSP efforts lead by Northwestern University
nor during the subsequent CPS Office of Math and Science, have teacher outcomes based on these courses been systematically collected across the district. In fact, only beginning in 2007 has CPS started to try to collect the teachers’ grades earned in these courses. While funding of their tuition has been contingent on their achievement of an earned B in the course, this had not been monitored. Neither is it logistically enforceable at this time to recoup from the teachers tuition funds spent on courses they earned less than a B on, or failed, or never attended. As long as the university had them officially enrolled, their tuition was paid.

Interestingly, because a number of the universities have sought and received grant funding from state or private agencies, they have been required to document teacher content learning and have often used pre- and post- testing of teachers in their courses and programs. For example, those funded by ISBE IMSP grants must report pre- and post-testing data to both the State and the Department of Education. To date, OMS does not regularly request these data.

Improved instruction

To what extent have the teachers prepared by the university content courses enhanced their instruction and their students’ learning? This question has not been addressed comprehensively on a district level to date. As of 2007-2008 there was not a CPS data system that linked elementary school teachers to the grades K to 8 students they teach. There also was not an internal CPS database that accurately documented when and how schools structured the teaching of their middle grades math and science courses and who taught them. Therefore, the district could not say to what extent teachers with endorsements were specifically teaching middle grades students in those topics. The databases could only offer the number of middle grades math and science endorsed teachers at a school, without differentiation of grade level and without linkages to the students taught.

For the strategy of enhancing teachers’ math and science content knowledge to impact students, the teachers in these programs would have to be focused on teaching math and science at their schools. CPS elementary schools are almost all configured to teach grades K through 8. Departmentalization of grades 6, 7, and 8 posed various challenges for schools even when they had endorsed teachers available. Teachers and principals in schools participating in the Chicago Community Trust and McDougal Foundation funded Cluster 4 Middle Grades Project described some of the additional challenges to their scheduling:

- Some schools could not come up with a departmentalized schedule that still preserved two hours of reading each morning—which schools believed was a district requirement.
- Discipline was a concern when schools departmentalized. They worried that student-teacher relationships would not be as strong as they were in self contained classrooms.
- Hallways would become noisy when students switch classrooms, especially if classrooms are on different floors.
- Protecting students’ personal belongings when students move from room to room was an issue for the many schools where students did not have lockers.

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24 Researchers have had to make site visits to schools to understand if the school departmentalized its math and science middle grades instruction. In one 2006-2007 study of 24 schools that were participated in a funded program focused on increasing departmentalization, most (~95%) grade 7 and 8 student cohorts worked with a teacher who specialized as the departmental teacher in math or science, one-half of the grade 6 student cohorts did not. One would expect the average CPS elementary school to be less often departmentalized in math or science.
Attendance-taking routines would need to change. If students switch classrooms, teachers need to take attendance in every class period (PRAIRIE, June 2007 and August 20, 2007).

On a district-wide level, there were only preliminary data on the extent to which teachers learn and are able to apply knowledge and skills they get from university-based math and science courses offered by the different universities across the years. A survey of 117 teachers enrolled in 11 university math and science courses across four universities found that teachers self-reported that their university courses were relevant to their own teaching. Over 80% of the teachers responding indicated that they agreed or strongly agreed that their course covered specific strategies to use with their own students, offered opportunities to practice specific strategies and discussion on ways students learn, and that they used content from the course in their classroom. Based on 2004 and 2007 – 2008 interviews with course instructors, teachers were sometimes given assignments that directly impacted their own teaching. There were a myriad of types of teaching strategies that teachers described as being discussed in their university courses and which they tried out in their own K-8 classrooms. These strategies included teachers having K-8 students:

- Work through in class a few problems rather than working quickly and individually through many problems
- Try out multiple methods of solving the same problem
- Work together in small groups
- Sit in desks arranged in a U-shape rather than in rows or groups of 4 to facilitate more discussion about the content
- Use their surroundings to think about the content, for example a teacher had students find fractions in their classroom like how the area of the door made up a fraction of the wall
- Do investigations using manipulatives and other materials
- Discuss math and science words on a “word wall” posted in the room
- Use reciprocal teaching where students “become teachers” and describe concepts and how to solve problems
- Work with their parents on homework assignments, for example having students explain a word problem to their parents and then have parents answer a question about the child’s strengths and weaknesses in problem solving
- Do peer teaching and have less teacher talk
- Use extended response to explain their answer
- Use “games” to reinforce lessons already taught

An example of assessing teacher learning.

One of the university partners working with CPS, Loyola University, has found some initial evidence regarding the influence of their expanded endorsement program—a three-year program designed to improve the quality of middle school science teaching. In summer 2005, twenty–three teachers from twenty-three different high-needs schools began a nine-course sequence of courses, including six science content courses and three courses on middle school science pedagogy. In addition to courses, participants engaged with research-active science faculty during enhancement sessions and academic year follow-up sessions. Teachers completed an action research project on the topic of their choice, in order to gain further insight as to how to improve their classroom practice.
Data collected addressed measurement of changes in teacher content knowledge, changes in instructional practice and changes in student achievement. Both quantitative and qualitative data were gathered to measure change in teacher content knowledge. In each content course, they found statistically significant gains in teacher content knowledge as measured by pre/post tests. Participants were also asked to write a series of reflections. All reflections were analyzed to identify important themes that emerged in response to each of the questions. Reflections found many teachers expressing a greater understanding of science content including: looking at science with a new outlook, better understanding of the connection between math and science, and increased personal confidence in content knowledge and teaching. Journal reflections also yielded information as to changes in instructional practice and identified themes related to this goal as well, including: using hands-on activities and lab activities to explain content, connecting the knowledge with other disciplines or real world phenomena, and paying attention to students’ prior knowledge and misconceptions.

Another data source for monitoring change in instructional practice was the Survey of Enacted Curriculum (SEC) (www.seconline.org) a self-report online instrument which had been used for analyzing differences in instructional practices in a variety of settings. (Blank, Birman & Garet, 2005) The SEC assesses what content is being taught by the teacher and how it is being taught. Loyola compared the responses of the 23 participants to 21 non-participating teachers from their schools as a comparison group. SEC data revealed that participating teachers, versus comparison group teachers, self-reported on the survey that they more often allowed students to work individually on scientific projects, modeled science for their students, engaged students in hands-on scientific experiments, encouraged students via journals and portfolios to self-reflect on their classroom experiences, and used technology in the classroom. Although these differences cannot be attributed directly to participation in Loyola’s program, it was encouraging to note at least some association between participation and classroom behavior. Analyses of how the teachers’ responses changed over the course of the program (ending in spring 2008) may also indicate whether the program impacted instructional practice.

Loyola has also begun to analyze the state assessment results of students in participant teachers’ classrooms. They can only analyze the data from teachers who teach 4th or 7th grades because those were the years in which state assessments in science were given. Among 23 participants, 13 teachers taught 4th, or 7th grade science. Data from two participants’ students were not available. Performance data from the remaining 11 participant schools were matched to comparison schools which were selected based on geographical location, school size, racial/ethnic make-up of the student body, and percentage of low income families. Tests of the difference in medians for the treatment and comparison schools indicated the median percent of students who met or exceeded standards in participants’ schools (median = 84%) was significantly higher than the median percent of students who met or exceeded standards in comparison schools (median = 74%, \( x^2 (1) =4.56, p < .05 \)). Thus, students attending schools of participating teachers seemed to meet or exceed State science standards at a higher rate than students in matched comparison schools. Once again, these differences can not be causally attributed to Loyola’s program or their teachers’ success in the classroom. Loyola intends to extend this analysis to assessment data from the same sets of schools in academic year 2004-2005 (pre-program) and 2006-2007 (year 2) as the data become available. This would help to understand if the differences observed were consistent.
iii. Sustainability

Partnership model shifts

The structure of Chicago’s system of support for teachers pursuing deeper math and science content knowledge has moved through various phases. The bulk of this structure though has remained centered on local universities partnering with the district but reliant on federal and state policies for setting the context and on federal, state and private funds for fueling the system. The phases of this part of the system included the

- 2000 – 2003 development phase,
- 2003 – 2007 scale up phase, and

The district’s model of providing tuition support to teachers enrolled in university graduate courses in math and science began with the NSF-supported Chicago Urban Program (CUSP) in 2000. Between 2000 and 2003, CPS subcontracted faculty at Northwestern University who recruited and then directed nine additional university partners who developed, piloted then refined prototype graduate math and science courses for CPS elementary teachers. In 2003 when the CPS Office of Math and Science was formed, direction of the university partnerships was taken on by the OMS staff. At that time support was given for teachers enrolling in programs of study, not individual courses. These programs were approved for support by OMS if they met a number of criteria. One key criterion was if they met State of Illinois requirements for math and science endorsements. In 2007-2008 the university courses continued but several new policies were crafted and put into place. The CPS Office of Math and Science designated a larger proportion of a staff member’s time to serve as liaison to university partners and to formalize a data system so that the district had more accurate information on the experiences of the teachers they supported with tuition funds. At the same time, the long term expense of supporting this program was trimmed and CPS announced that instead of paying teachers’ tuition for university programs, they would instead offer teachers low interest loans to take these programs. In parallel, the district launched a Specialization policy that requires principals to hire middle grades teachers with math and science endorsements according to a specific quota.

The relative responsibility for supporting the teachers in this program shifted with each of these phases. It is yet to be determined the extent to which these shifts set the initiative up for a more sustainable future. The figure below summarizes who was responsible for what and when.

The figure below summarizes how the university courses initially began with heavy support from the NSF CUSP grant to Chicago which, while administered by CPS, was heavily supported and directed by a team of science and math educators at Northwestern University. Spurred by a critical NSF site visit mid-grant, the Chicago Public Schools changed both how it coordinated the CUSP grant but also how it ran math and science education overall in the district. The new Office of Math and Science took over logistical and administrative control (noted in red on figure) and university partners took on the teaching and design of the courses (noted in blue). After the NSF CUSP grant ended in 2005, the funding teachers taking these university content courses was picked up by the district along with State and private agencies (noted in green). New funding programs are also slated to begin in 2008-2009 that shift additional responsibility on the teachers themselves through loans.
This figure offers a rough overview of the progression of these partnerships. More refined attention to how administrative, course design, funding and accountability functions have changed provide additional nuance. We will explore shifts in the latter functions in some detail next but first offer brief comments on administrative and course design work.

Figure 16 Distribution of responsibilities for university-based math and science programs and courses for elementary teachers within Chicago systemic reform 2000 - 2008

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<tr>
<td>Faculty taught courses</td>
<td>Faculty taught courses</td>
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<tr>
<td>Cross-university design team for each course</td>
<td>University pays faculty</td>
<td>University pays faculty</td>
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<td>University designs programs</td>
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<tr>
<td>Teachers as co-instructors for courses</td>
<td>OMS: Partial tuition paid for all teachers</td>
<td>OMS: Partial tuition paid for all teachers</td>
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<tr>
<td>Recruit teachers to take courses</td>
<td>Recruit teachers to take courses</td>
<td>Recruit teachers to take courses</td>
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<tr>
<td>OMS approval of university applications for new programs (Begins 2003)</td>
<td>Register teachers for tuition benefit</td>
<td>Register teachers for tuition benefit</td>
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<tr>
<td>Database records</td>
<td>Approve university program applications</td>
<td>Database records</td>
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<td>Approved courses</td>
<td>OMS</td>
<td>Approve university program applications</td>
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<tr>
<td>Internal evaluation</td>
<td>Funds for teacher co-instructors</td>
<td>External evaluation funded</td>
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<td>External evaluation funded</td>
<td>Department of Program Evaluation: Internal evaluation</td>
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<tr>
<td>District teachers take courses voluntarily</td>
<td>Some district teachers take courses voluntarily, and others asked to take courses to met NCLB high qualified status</td>
<td>Beginning in 2008-2009, New district policy will begin to phase in additional accountability on schools to assure that middle grades teachers have subject matter endorsements</td>
<td></td>
</tr>
<tr>
<td>Teachers pay no tuition for courses</td>
<td>Teachers pay partial tuition remaining after district and grants to universities pick up a portion (and in a few cases all)</td>
<td>--Some teachers will be offered low interest loans to cover tuition rather than district tuition coverage</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Directed by CPS administrator</td>
<td>Directed by new CPS OMS chief officer</td>
<td>Directed by CPS or university partner</td>
<td></td>
</tr>
<tr>
<td>Course development by Northwestern with cross-university teams: Develop course guides for future instructors</td>
<td>External evaluation by new evaluator</td>
<td>External evaluation funded for grant</td>
<td></td>
</tr>
<tr>
<td>Internal evaluation by Northwestern</td>
<td>Partial tuition paid for teachers</td>
<td>Partial tuition paid for teachers</td>
<td></td>
</tr>
<tr>
<td>External evaluation by consultant</td>
<td>State and Private grants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site managers for each course who: -Manage materials -Register teachers and database records -Monitored and collected data on courses</td>
<td>Directed by CPS or university partner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faculty stipends</td>
<td>External evaluation funded for grant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funds for teacher co-instructors</td>
<td>Partial tuition paid for teachers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full tuition paid for all teachers</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

In years piloting the courses, each course had a manager and the CUSP grant had a manager and multiple lead faculty. In 2003 when management of the tuition payments and record keeping for the
courses went to CPS, this was staffed by an OMS staff member who also had other duties. And number of courses and number of teachers enrolled at a given time more than doubled. Added to this, CPS staff members overseeing this work turned over at least 3 times in five years. By 2008, OMS had increased staffing around university-based activities and employed a full time staff member with the title of University Based Program Coordinator.

Many of 2003-04 faculty teaching were on design teams that created the course pilots in 2000-2002. In 2003-2004 there were 11 faculty serving as instructors of 19 math and science content courses targeted at middle grades teachers. In 2007-2008, there were 28 courses offered and 23 different faculty served as instructors. It is of interest to consider how the new “generation” of faculty (those not involved in early CUSP pilot development) teaching these courses are teaching using the CUSP model as intended by the early developers.

Funding shifts

Flexibility has been a trait of how Chicago stakeholders collaboratively funded university content courses for teachers. Many university partners recognized by 2003 that they needed to seek additional funding sources for courses because the NSF CUSP grant would end in 2005. In addition, the private university saw that they needed outside funding to pick up additional teacher tuition for their courses. The 2003 levels of district partial tuition support for teachers, while recognizing and addressing to some extent the higher tuition rates at private universities still created a program where teachers choosing to take courses at the private universities had to pay more. The private universities wanted to be competitive with the local public universities who also offered content courses. By 2004, three of the private university partners had secured State and private funds to subsidize tuition for their courses for teachers. These universities remained very active through 2008 in enrolling teachers in their courses. Other private universities had not obtained similar funding and had not been successful in enrolling teachers in their approved programs.

In 2008 the district was developing a new program to replace their tuition payments to universities with low interest loans to teachers. They cited that the cost of tuition was too great to sustain.

Accountability and incentive shifts

There have been many incentives but also some disincentives for schools and districts to encourage teachers to take courses, seek endorsements and learn content knowledge; for teachers to take free or subsidized university courses, gain credits and endorsements; for universities to offer courses for teachers; and for faculty to teach these courses to teachers.

Schools and districts

[Forthcoming on response to NCLB and State requirements]

By spring 2008, district leaders were working on a new policy on teacher specialization that would encourage teachers to gain more content knowledge and become endorsed in content specialties. The current and former Chief Officers of Math and Science were engaged with other CPS leaders, lawyers and the teachers union to determine specific plans. Middle Grades Specialization Policy 08-1022-P01 passed with amendments October 22, 2008. See http://www.cps.edu/About_CPS/The_Board_of_Education/Pages/Actions2008_10.aspx.

Teachers
[Forthcoming on how teachers make sense of their performance and grades in classes given: Specific grade needed to get state endorsement? To get tuition reimbursed by OMS? To get into a MA program?]

University level

[Forthcoming on how the universities insist on autonomy and the district wants accountability around applicability to teachers’ classroom instruction]

By 2005 both DePaul University and Loyola University had received grants from the Illinois State Board of Education (ISBE) for the professional development of elementary teachers of math and science. They used these funds to leverage their creation of master’s degrees in science education. By 2007, the ISBE had altered their math and science grant program to require all grantees to create master’s degrees for either elementary school or high school teachers of math and science. By spring 2008, 24 master’s degree programs in math and science were proposed by universities from across the state and had planning grants from ISBE. Five of these planning grants went to universities in Chicago who were partnering with CPS: DePaul University, Illinois Institute of Technology, and Loyola University.

[Forthcoming on influence of move to low interest loans rather than tuition payments]

Table 14 Number of district supported classes offered per academic year by university

<table>
<thead>
<tr>
<th>University</th>
<th>2001-2002 classes</th>
<th>2002-2003 classes</th>
<th>2003-2004 classes</th>
<th>2004-2005 classes</th>
<th>Total number of classes offered</th>
<th>% of total classes offered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Univ A</td>
<td>21</td>
<td>22</td>
<td>27</td>
<td>31</td>
<td>101</td>
<td>42.1%</td>
</tr>
<tr>
<td>Univ B</td>
<td>3</td>
<td>2</td>
<td>13</td>
<td>24</td>
<td>42</td>
<td>17.5%</td>
</tr>
<tr>
<td>Univ C</td>
<td>6</td>
<td>5</td>
<td>15</td>
<td>13</td>
<td>39</td>
<td>16.3%</td>
</tr>
<tr>
<td>Univ D</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>11</td>
<td>16</td>
<td>6.7%</td>
</tr>
<tr>
<td>Univ E</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>14</td>
<td>15</td>
<td>6.3%</td>
</tr>
<tr>
<td>Univ F</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>13</td>
<td>5.4%</td>
</tr>
<tr>
<td>Univ G</td>
<td>3</td>
<td>6</td>
<td>0</td>
<td>9</td>
<td>9</td>
<td>3.8%</td>
</tr>
<tr>
<td>Univ H</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Univ I</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Univ J</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>&lt;1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>37</strong></td>
<td><strong>41</strong></td>
<td><strong>64</strong></td>
<td><strong>98</strong></td>
<td><strong>240</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Faculty

We asked course instructors to talk about what they found as advantages to teaching these courses and what their universities found worthwhile about their participation. Among the benefits mentioned were:

- Universities valued the tuition funds and new students the CMSI courses attracted
- University-school CMSI partnerships helped the university to fulfill community outreach missions
Universities developed and supported new programs and courses related to the CMSI courses
Universities strengthened ties to schools through teaching CMSI courses to practicing teachers which was useful in their work on their pre-service teaching programs
Faculty learned by working closely with their CMSI CPS co-instructors
Faculty gained opportunities for scholarship, grant-writing, and service work through their CMSI courses

Interviewed instructors spoke about the value their universities placed on the partnership as a way to bring new students to their campuses. In particular, the CPS request offered some institutions a chance to, as one instructor put it, “break into the business” of teacher professional development for CPS teachers. Universities were excited about the “potential to grow” in this area. Instructors at several of the institutions spoke about how these programs gave them a chance to gain more name recognition with CPS teachers. One explained that his institution was “underrated for a lot of years” despite their good work with teachers and that this program could help them move to “another level of importance in the Chicagoland area.” More established universities in the teacher professional development work saw an opportunity to increase the numbers of students to their courses. One instructor whose university already was well known to CPS teachers spoke about how the programs might lead teachers to commit even further in pursuing their development and join the university’s masters’ degree program.

The participating private universities were positive about the tuition stipends teachers received from OMS. One of the instructors talked about this in the following way:

... elementary teachers have to have ongoing professional development ... And so we could position ourselves to do some of [this]. But traditionally we haven't been successful with that because we're so much more expensive than the state institutions. So that's been a real drawback. But with the CUSP, there was a potential to have the tuition, you know, have tuition taken care of and so I made a case for us.

Staff from these universities was optimistic about how the tuition stipends could draw students. These staff were disappointed when they were not able to meet adequate enrollment numbers for their CMSI courses. There was concern by some at private schools when their university needed to discount tuition at special rates for CPS students. One person pondered whether they really “owed” this to CPS. There was also a comment made regarding the long time period needed to get these courses into the university’s plans and the short timeframe on which CPS operated.

Instructors also made it clear that negotiations internal to their departments and colleges had to go on in order to free up their time to teach these CMSI courses and, in some cases, to give teachers additional tuition breaks to better compete with other universities. The instructors of their courses often had to “sell” the CMSI courses to their Deans and other university administrators.

You know they [the University] had to invest my time and agree for me to do it and it counted as part of my load ... So I convinced [several upper administrators at the University]. And I think, you know, [these administrators] have been real supportive. ... It's, I see it as kind of a risky thing ... for [our University] to do this ... it takes. ... I mean it's already taken a good deal of my time. We've had a couple of committees and the Provost's been involved. And I'm spending so much time this summer working on a proposal for a four course sequence that I'm trying
to sell to the administration here. . . And I am pushing that, you know, that we [at the University] should give a tuition reduction because we're, it's part of our mission to work with CPS teachers and we aren't really doing that now. And if we do that, then we are, we become close to competitive with University X, University Y and those places.

There were implications for universities offering these courses on their staffing needs. One university instructor mentioned this in terms of her thoughts on sustaining these programs. This instructor noted that the creation and teaching of these courses rested with a relatively few individuals, some of whom are adding this to an overfull workload. However an instructor at another institution explained with pleasure that the university had just hired a new person to also work on math/science education teacher professional development—noting that this could help ease his workload because “there’s a limit to how many nights I can work!”

Aside from enrollment and tuition, some of the universities saw their participation as part of their service to the community. Some of the instructors, especially those at one university, spoke about how the program helped them fulfill the university’s “agenda of social justice” and service to their neighborhood schools.

There were a couple situations where university instructors spoke of how these CMSI courses had influenced other courses and programs they were working on. One instructor explained this:

*I mean [my university] is fully supportive of the program. In fact, you know we’re now designing a [new masters degree program] based basically on the same model. We’re now realizing that the components that they built into CUSP courses are indeed really important. Now we have a year of experience of teaching such courses. And so you know [my university] is excited about this, you know, designing courses that specifically meet the needs of in-service teachers. We’ve learned from CUSP.*

Another instructor felt that working on the CMSI courses helped as she also worked on her university’s pre-service teacher program. In addition, it was a means to develop some stronger relationships with teachers at local schools—schools that also helped through hosting pre-service student teachers.

As individuals, a few faculty explained that they learned something important from teaching these courses. In particular, some of them noted that they learned through co-teaching with a practicing CPS teacher. This was common for faculty interviews during the 2002-2003 year (Wenzel et al., 2003). However during 2003-2004, very few of the university courses had teachers co-instructing with the faculty because the salaries of these teachers would have to be partially paid by the universities rather than being fully paid by CPS. This presented the universities with a financial problem. Typically, universities budget for a faculty member to teach a course. If they don’t get a large enrollment, there is no budget to pay an additional person. So building two instructors into a course is not part of the normal budget.

Finally, as individuals, faculty could and some did contribute to their career/tenure portfolio by not just teaching, but also doing research and service related to the CMSI courses. A couple of the faculty told how they either have already or hope to publish and present scholarship around their teaching experiences in this program. For example, one of the university faculty and CPS co-instructor pairs co-authored a paper they presented at a professional conference. Others explained
how they were heavily involved in serving their university as a designer of larger efforts in teacher pre-service and professional development related to this program. Still others had been involved in writing and receiving grant funding to cover their efforts with this and related programs. All of these activities were hoped to be positive steps for the faculty instructors as they pursued their careers at the universities. However, some faculty expressed that through their support of the program, they took on some risk to their reputations that depended on the successful and continued enrollment in their CMSI courses.

Both the universities and individual faculty found significant benefits from their participation. These were all issues that could help them to continue to participate as partners with CMSI. However, as mentioned in the previous sections, these benefits came in tandem with a great deal of work on the part of faculty and at times some dissatisfaction with the support they received for their work and disappointment in low enrollments for their courses.

The availability of these courses and programs relied heavily on the tuition subsidies that OMS gave to the teachers taking these courses. University instructors interviewed mentioned this. For example in 2004, two spoke at length about how challenging it was for the private universities to recruit teachers to their courses without the significant subsidies. They spoke about their challenges in working with OMS and their universities to deal with issues like getting the universities to cut tuition to make the course more competitive in cost and to see if the courses could be larger to make the course more attractive to the university. One instructor noted the issues in this way:

> If we don't have Board money, then we can't do it. What teacher is going to be willing to pay, you know like $2,000 to take a course, . . . [when other universities are] offering them, you know, they have grant money. . . . But there are plenty of programs around where teachers have to pay almost nothing. And so we're going to be asking students to pay $2,000. It ain't going to happen. So I guess one of the real difficult things for me is on the one hand I'm trying to convince people [at my university] we ought to go for this. But . . . if we go for it, we invest the time and effort and then a year or two from now we got this thing up and going and then there's no more tuition money, then who looks bad? Me. I've invested university resources in a program that we have to scrap. So, I mean, it all makes me kind of nervous.

The active recruitment of teachers to these courses is critical. The enrollment of teachers into these courses was not always consistently high even with the tuition subsidies. We examined the K-5 and Middle Grades endorsement program courses advertised in fall 2003 catalog to be taught winter 2003 through spring 2004 and in the summer 2004 and winter 2005 Catalog to be taught in the summer of 2004. Of the 52 courses that were scheduled to be taught, 5 of the courses had to be cancelled due to low or no enrollments.

Asked by one of the evaluators about cancellations and low enrollments in other courses, one instructor explained that she would keep offering the course, but worried that the university had their doubts about the continued feasibility of this:

> . . . but if something doesn’t change I’m running out of believability. People say I’ve heard that before. So if I didn’t believe in it, it wouldn’t be picked up.

All of the cancelled courses were at private universities. Instructors interviewed mentioned their concern for how higher tuitions made recruitment to courses at most private universities more
challenging. Several faculty expressed frustration that more active recruitment, in addition to the catalogs, was not undertaken to help avoid the cancellations.

Several instructors talked about how important and helpful it was to them that OMS coordinated the recruitment. One instructor noted about the process in 2004:

> The coordination, the catalogue, the taking enrollments, and being able to advertise it for us to have a central location to deposit this. The catalogue is extremely helpful for us to look at. Who was offering what courses when? Where did we fit in? To me that’s been extremely helpful—that administrative piece..

Another instructor commented in 2004 on a number of ways that the recruitment and enrollment process could be improved. For example, in several recent courses teachers had not received CPS acceptance letters (as of halfway through the semester in one case and as of the last day of the course in another) confirming their enrollment in the course/program. Further, according to one instructor the applications that the students filled out for CPS did not provide the instructor with useful information about the teachers enrolled in the course. The process of working on the enrollments was also made more difficult because it was unclear who made OMS policy decisions about the courses. The record keeping methods of course enrollees was done at OMS with paper rosters. The system, at times, has made it difficult to identify which students took which courses.

CLICK HERE TO SEE LIST OF SELECTED ORIGINAL EVALUATION REPORTS RELATED TO THIS TOPIC
e. Assessment Systems

i. Context

Over the last few decades education has been heavily influenced by the standards movement (Education Week, 1999). At the national level, several organizations have developed and disseminated standards which include mathematical and science content knowledge and skills that should be taught in schools. For example, the National Council of Teachers of Mathematics (2000), Science standards, Achieve, and New Standards (New Standards, 1997) to name just a few. In addition, most states and large school districts have also put in place standards describing what students should know, often at each grade level or range of grade levels. In order to implement these standards based systems, states and school districts have invested heavily in assessment systems. Throughout the 1990’s states and districts increasingly attached more high stakes ramifications to assessment results and this trend has continued at the national level with the passing of the No Child Left Behind Act of 2001 (“NCLB”).

These trends have also been evident in Chicago Public Schools. Beginning in 1995, Chicago undertook one of the largest efforts to “end social promotion” by attaching high stakes consequences, barring individual students from advancing to the next grade level, based on their results on the nationally norm-referenced Iowa Tests of Basic Skills (“ITBS”) in reading and mathematics for students at the elementary level. At the high school level the district employed a nationally norm-reference assessment the Test of Academic Proficiency (“TAP”) as well as district constructed course exams called the Chicago Academic Standards Exams (“CASE”). In addition, schools received a gamut of sanctions, ranging from probation to reconstitution, based on their school’s performance on these assessments. Over the last ten years the district has gradually relaxed the high stakes nature of these assessments and eventually replaced their use with that of the statewide NCLB mandated assessments.

The State of Illinois has also administered a statewide assessment for some time. Beginning in 1999 for mathematics and reading and 2000 for science, the Illinois State Board of Education (ISBE) transitioned the state student assessment from the Illinois Goals Assessment Program (“IGAP”) to the Illinois Standards Achievement Tests (“ISAT”). With the passing of NCLB, the state of Illinois reconfigured ISAT in 2005 to assess students statewide each year in March in grades 3-8 in mathematics and reading and grades 4 and 7 in science. In April of each year, the Illinois State Board of Education administers the Prairie State Achievement Examination (“PSAE”) to high school students in the 11th grade. This large scale assessment including components in English, reading, mathematics and science, is comprised of three parts, including a full ACT assessment. In addition, with the passing of NCLB, these statewide assessments (ISAT and PSAE) have become increasingly more high stakes for schools, including becoming the basis for determination of a school’s annual yearly progress (“AYP”) indicator with all the concomitant sanctions for schools prescribed under the Act.

In addition to sanctions due to poor performance on these statewide assessments, the district has moved in recent years to also providing rewards to schools for positive performance, based on both absolute attainment and gain metrics for schools. These rewards include such things as autonomy from certain district mandates, additional teacher compensation, and more flexible school budgeting. While the district has changed the assessment used for making student retention decisions from the ITBS to the ISAT and has incorporated additional measures (including student grades, attendance,
and teacher recommendations) into its promotion policy, as well as adding potential rewards for teachers and schools, the ISAT and PSAE are still seen as high stakes assessments for both students and schools in Chicago.

Within this context of high stakes accountability, there is a recognition that assessments can serve other purposes as well. In fact, the purpose of an assessment determines priorities and imposes constraints on the design of the assessment. While at its foundation all assessment practice is the process of reasoning from evidence, assessments must have different characteristics based on for what purpose they’re designed. While some assessments like those used for high stakes accountability are summative assessments of learning, other assessments such as curriculum-embedded assessments as well as other classroom-based assessments are designed to be formative assessments to aid learning (Black and Wiliam, 1998). Furthermore, there has been an increasing body of research in the cognitive sciences about how people learn (NRC, 1999). This work is leading to re-examining the role of assessment in education (Knowing What Students Know, 2001). Assessment does not exist in isolation, but must be closely aligned with the goals of instruction and curriculum. Of course, all of these assessments must possess the requisite psychometric properties of reliability, validity, and fairness though the criteria for each property might be different depending on the purpose of an individual assessment. Thus one challenge for school districts today is designing assessment systems, utilizing the lessons from cognitive science research, that recognize the need for different assessments for different purposes and balances the need for both large scale and classroom based assessments.

This has been a particular challenge in the Chicago context since for a decade or more assessment has only focused on the high stakes accountability aspects of assessment. In addition, many of the assessments that had historically been used in the district have failed to have the requisite psychometric properties for the purposes they are used for. It is within this context that district leaders attempted to develop components of an assessment system to help teachers and district staff to use assessments for learning in mathematics and science.

ii. Vision: Envisioning through enactment

Coherent policies

For an assessment system to support learning, one characteristic it must have is what the National Research Council’s Committee on the Foundations of Assessment, refers to as coherence. They define this to mean that “as one moves up and down the levels of the system, from the classroom through the school, district, and state, assessments along this vertical dimension should align” (NRC, 2001). This notion of coherence fit well with the other efforts at coherence the district was attempting to make in its mathematics and science reform strategies.

Recognizing that the district was removed from the locus of control of assessment at the state level, initiative leaders used a variety of strategies to attempt to either buffer or bridge the ramifications of the state testing program on CPS stakeholders in order to achieve district coherence for assessment practices in mathematics and science. On one hand they attempted to bridge state assessment policies by nominating individuals to be part of the state’s review committees for the assessment development process. Additionally, they provided feedback to state leaders concerning assessment proposals. On the other hand, they attempted to buffer school staff from some of the potential incoherent
ramifications of the high stakes exam by providing documents concerning test preparation strategies. At the district level, initiative leaders sought to develop components of an assessment system that would serve a different purpose than the statewide, high stakes assessments, but be coherent with them. On the elementary side, a process was undertaken to develop a system of benchmark assessments in mathematics. It was envisioned that this system would have several characteristics, namely:

- Provide information in a useable way to teachers and students about student learning of the Illinois Learning Standards and to help inform instruction.
- Provide administrators and teachers with ongoing measures of student performance to help schools target areas of need.
- Use formats consistent with the state’s large scale assessment.
- Deepen teachers’ content and pedagogical knowledge by promoting dialogue among teachers about student learning.
- Build and develop norms for reflective practice.
- Be reliable and valid for the designed purposes.

The district attempted to develop this system by bringing together individuals with a range of expertise including university faculty with knowledge of assessment, psychometric measurement, and cognitive sciences research; district staff with knowledge of the Illinois Learning Standards and district supported mathematics curricula; and teachers with knowledge of their students’ learning needs and abilities.

In collaboration with Dr. James Pellegrino’s group at the University of Illinois at Chicago, the district designed and implemented a standards-based assessment system in mathematics. In 2004-05, the district collected and categorized according to the State of Illinois’ Learning Standards over 1,000 mathematics items in grades 3-8. A pilot test was then conducted to establish the psychometric properties of these items for CPS students. Using a matrix block design similar to that used for the National Assessment of Educational Progress (NAEP), the pilot test involved approximately 500 items in 24 schools, involving approximately 250 classrooms and 6250 students. From the results of this pilot test, 3 benchmark assessments (one for the fall, winter, and spring) were constructed for field testing in 2005-06. This field testing involved: further testing of the items, testing of the extended response scoring procedures, and an examination of alternative models for district-wide administration. It involved over 10,000 students in grades 3-8. It utilized a unique approach to assessment involving teachers in the scoring process of extended response items, sharing of multiple choice distractor analyses, and incorporated professional development on assessment literacy directly into the process. The district expanded this work to all elementary schools in the 2006-07 school year. The district also partnered with a private sector vendor to increase the item pool and handle the logistics of administration. Finally, the district utilized a technology platform for the dissemination of assessment results at the school, grade, classroom, and student levels.

27 All of the developed benchmark assessment materials can be found on our website at: http://cmsi.cps.k12.il.us/ViewProgramDetails.aspx?pid=157
In seeking to meet its goal of coherence for the benchmark assessments, the district developed the forms to have the same types of item formats (multiple choice, short answer, and extended response) that appear on the state’s high stakes assessment. In addition the same rubric for scoring extended response questions as used on the state assessment was employed. Additionally in an attempt to increase district assessment coherence, the district collected, and using panels of both external measurement experts and district teachers, scored actual CPS student work to use as concrete exemplars at each dimension and score point of the rubric. These exemplars along with scoring guides were disseminated to all district staff28. Also as the coherence of district instructional materials has increased, the benchmark assessments have been refined to more closely match the instructional pacing of the district supported mathematics curricula.

At the high school level, the district has built upon this work to develop, in partnership with university staff and a private test vendor, four benchmark and summative course assessments for each of the core high school mathematics, science, and English courses developed as part of the district’s High School Transformation Initiative. This involved different benchmark assessments for each different IDS provider closely aligned to their specific curriculum content and pacing, as well as a common summative assessment. The process of creating an assessment framework for each assessment, item writing, pilot testing, field testing, reporting, and correlating with the state PSAE assessment for the high school assessments, mirrors that used for the elementary benchmark project.

In an effort to establish coherence at the school level, the reform leaders encourage school staff to establish time to meet together to discuss assessments and their results. Also as a way to bridge the elementary-high school divide, the reform leaders used assessment to provide a platform for increased coherence. This was done through the development process for an end of course 8th grade algebra assessment. As the district moved to encourage more middle grade students to take Algebra prior to entry into high school, it was necessary to establish some consensus around what it means to have a mastery of Algebra, notwithstanding what grade level it is taught. By working with both high school and elementary teachers and leaders to create an end of course assessment, the district sought to create instructional coherence around Algebra.

At the classroom level, the district addressed the reform’s goal of increasing coherence by focusing teachers on using the assessments embedded within the district supported curricula29 as well as focusing on helping teachers analyze student work. Working with external assessment experts, the district undertook a project to capture the nature and use for the curriculum-embedded assessments. The initiative leaders also developed protocols for examining student work and incorporated these into the district provided, curriculum-specific professional development sessions.

Taken together these efforts have attempted to create a coherent assessment system by incorporating several different elements. First, they attempt to address vertical coherence between classroom assessment, district benchmark assessment, and statewide high stakes assessment. Second, they address content coherence by attempting to closely match the developed assessments with the content and pacing of district supported mathematics and science curricula at both the elementary and high school levels. Third, the efforts address issues of format coherence by utilizing formats similar to the

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statewide assessments on the district benchmark assessments as well as using formats similar to those
used in the curricula on both the classroom embedded assessments and the district benchmark
assessments. They also seek to address scoring coherence by providing guides with actual student
work examples as well as using similar scoring rubrics as those used in the statewide assessment.
Also by providing training to teachers and district staff and employing and modeling interrater
reliabilities techniques scoring coherence is improved. Finally by providing training modules and
materials the district attempts to address coherence in training though given the size of the district,
variability in presenters and assessment literacy among district staff this has continued to be a
continuous challenge.

Workforce development

The district used a variety of approaches around assessment to attempt to reach its goal of improved
workforce development in mathematics and science. As part of the development process for the
elementary mathematics benchmark assessments, the district employed a two-model strategy for
workforce development during the pilot stage. In one model, all of teachers in 12 schools were
brought together by grade level (3rd-8th) three times of year. These teachers were trained in
assessment literacy topics and well as specific techniques for evaluating and scoring student
assessment responses. They brought their actual students’ assessment responses to the training
sessions and worked with their colleagues to evaluate them. In the other model, 15 schools each sent
one teacher at each grade level 3-8 to a similar training experience. In this model, the expectation
was this teacher could lead a similar session for the other teachers at that same grade level at their
school, in essence, a “train-the trainer” model of professional development. Additionally, the district
provided professional development around assessment literacy for district mathematics and science
leaders. These leaders were provided with a suite of district-developed tools that could be used in
leading their own professional development activities in their sub-districts or individual schools.

Improved instruction

Initiative leaders envisioned reaching their desired goal of improved mathematics and science
instruction by using the assessment system developed by the district to reflect their focus on
challenging mathematics and science problems. These problems would reflect the type of tasks they
wanted district students to know and be able to do. In this way, the district would illustrate its
expectations for students and, in turn, teaching. They desired teams of grade level teachers reviewing
student work and discussing it in a way that research suggests (Black & William, 1998) is effective at
improving their own instructional practices. In fact, through the process of teachers discussing and
scoring real student work collaboratively, several conceptual misconceptions of mathematics have
been surfaced not only by students but by teachers as well.

iii. Sustainability

Scale up

In order for the district’s assessment strategies to be sustainable several factors were incorporated by
the initiative leaders into the conceptualization of the plan. First, in order to be most effective the

30 Provide hyperlink to these PD modules: http://aim.psych.uic.edu/courses/aim/course.asp?idCourse=75,
http://aim.psych.uic.edu/courses/aim/course.asp?idCourse=78,
http://aim.psych.uic.edu/courses/aim/course.asp?idCourse=79

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assessment system needs to be done at the scale of the district. This has been a challenge for several reasons, including the time necessary to administer, score, and report findings at the classroom, school, and district levels. Also the district needs to develop an electronic reporting portal for sharing results with school staff in a timely and customizable way, yet ensuring the results and both valid and easy to understand. Given the variability in district pacing and content coverage a solution involving more customization of form development including perhaps a test item bank or adaptive assessments might be needed in the future.

Second, the creation of partnerships with external vendors and universities is seen as necessary. Several different skills sets are needed to make the development and implementation process possible at the scale necessary. The district has been fortunate to work with several university assessment experts in the conceptualization and development of an assessment system that hopes to be vertically coherence across levels of the system. Additionally, being able to work with the developers of the district-supported curricula both on revisions to their own curriculum’s embedded assessments, but also on appropriate items and forms for the benchmark and end of course summative assessments has also been crucial.

Third, item pools while reusable to a greater extent than in high stakes assessment, still needs to be replenished over time in order to maintain the sustainability of the assessments. Training materials that can be modified and used by a wide variety of stakeholders is also seen as important for long term sustainability.

Buy in

Another important component for the long term sustainability of the district assessment system is the need to create buy-in from a variety of stakeholders. This has been challenging to accomplish given the site-based control that is prevalent in CPS. Individual schools have a wide latitude in, if and when, they administer non-high stakes assessments, whether or not time is provided for school staff to collaborate on the evaluating and scoring of student assessments and work product, and how to use the results of assessments. Additionally, given the range of instructional materials and pacing in the district it is impossible to design a one-size-fits all model. However having teachers and school staff involved in the assessment development process and scoring while increasing their work load and lengthening the form development process, appears to be crucial in developing the needed buy-in to the process from school staff.

Of course, the approach of using assessment for learning rather than of learning, as well as using assessments in a non-high stakes manner, is a large philosophical shift for a large number of district stakeholders. This necessitates the allocation of a significant amount of time which is often hard for the district to implement. Also the ability to support the appropriate use of these assessments is a continuing challenge of staff development.

CLICK HERE TO SEE LIST OF SELECTED ORIGINAL EVALUATION REPORTS RELATED TO THIS TOPIC
4. LESSONS LEARNED

The research we present in this document offers insights to consider when working to improve math and science education reform and when attempting to study it. These insights come less in terms of concrete recommendations than by way of subtle lessons learned and by way of the many questions that are raised. We offer a selection of these lessons and questions below. Then we call for readers of this document to react with their own lessons and questions. We would like to append these comments via hyperlink to this document and actively engage together to build knowledge about systemic reform in math and science education. Please email your comments and questions to: swenzel@luc.edu.

a. Centralized and localized control

The story that we tell in this document of Chicago systemic math and science reform is greatly influenced by Chicago’s environment of local control for schools (required by 1988 state legislation) and the movement back toward more centralized controls (with 1995 mayoral take-over of the district) and continuing as the district enacted accountability policies citing No Child Left Behind legislation and created the district Office of Math and Science. For example, in section 3a we wrote about the adoption of curricula materials that is encouraged by the district but which has to be voluntarily chosen and bought by school administrators—unless their school has lost freedom to control their own budget due to poor student achievement on standardized tests.

Another issue complicated by the divided location of control is that of policy enforcement. In section 3d, we wrote about how OMS paid for teachers’ tuition for university programs on the condition that teachers earned a certain grade and continued teaching in the district. We wrote about the challenge schools had scheduling classes so that all middle grades math classes had the required 60 minutes a day. We described that only teachers endorsed in math or in science should be teaching departmentalized classes in these content areas. In all of these cases, we noted that these policies are broken and that there are not adequate methods of documenting compliance, let alone enforcing it.

Much of data we consider in this document was collected originally in service of program evaluation designed to be useful to the architects of the reforms who were located centrally in the district. We recognize the need to continue to assess how this perspective has influenced the view we give in this document. Even given this slant to what we have viewed, this document offers a message that ultimately it is the local events at a school and in the lives of teachers that mediate any of these reform efforts.

Given the importance of this environment balancing central vs. local control, we wonder what might we learn if we look back at pre-2002 and pre-1988 math and science education in CPS—before the time of a centralized Office of Math and Science and then before the days of local school control?

b. Teachers, classrooms, instruction and students

The data used in this current study was strong for understanding contextual and district facets of reform, i.e., the top part of our diagram and framework in Figures 1 and 2. Our understanding of the classroom lens and student outcomes is less developed. We recognize our need to shift our focus to teachers and instruction, namely, by gathering and analyzing high quality data on how teachers make sense of contextual and district reforms and shape their practice in ways that impact the classroom and students. Researchers of large-scale school reform efforts call for attention to teacher engagement with the reform (meaning classroom instruction, peer interactions and professional development), as
these relate to students’ learning. We need to examine the nature of the reform effort’s adoption and adaptation – how and why teachers engage with a particular reform, how and why their engagement affects their instructional practice. This is crucial to the understanding of if and how a particular reform is or can be successful, and under what conditions (Gitlin & Margolis, 1995; Hamilton et al., 2003; Wenglinsky, 2002; Wright et al., 1997). In a proposal we recently made for additional DRK-12 funding, we have designed a new study of the Chicago reform that draws on research outlined in this paper and addressing calls to advance education policy implementation research by confronting both the complexity of math and science systemic reform and exploring policy influences on the learning processes of teachers and students (McLaughlin, 2006).

c. Sustainability

Teachers in the Chicago Public Schools have seen many reform initiatives come and go. They often say about the reform du jour: “This too shall pass.” However, the math and science initiatives have been underway for 5-plus years. Why have they not passed? What might trigger their passing?

We have many ideas on this that we will be developing further. We note some of these ideas below:

- Millions of dollars have been invested in tangible resources like books and science kits. Does this, and if so, to what extent does this anchor this initiative for longer sustainability?
- External funding has remained robust for the 2003 to present initiatives. How is that a Chicago-specific or math/science-specific situation? How has funding availability shaped the direction of the reform?
- Much of the systemic reform is laid out by various programs. If the programs go away, to what extent might the policies put in place influence the future?
- There are shifting situations related to who takes responsibility for what roles/resource provision within the initiative. How is this settling out and does it (or not) make sense for long term sustainability?
- Evaluation of these programs has been substantial. Teachers have actually remarked to evaluators that they have more faith in the seriousness of the district to maintain this reform direction because, as the teachers say (to paraphrase), “Someone actually cares about how this plays out in my classroom.” Do, and if so, how do the evaluation process and findings influence sustainability of the present initiative?

d. Workforce capacity building

There are issues we raise in this analysis about the need for retraining teachers and instructional leaders in the vision and skills of this initiative given personnel turnover over time. There are questions about how to maintain the quality of skills and coherence of the vision given the various strategies chosen for who delivers professional development. The initiative rests on a foundation of having effective high quality professional development. Yet the monitoring of quality is uneven at best. Further, questions remain as to the effectiveness of using professional development leaders or professional learning communities or other strategies.

One lesson that emerges from the CMSI concerns the effect that train-the-trainer professional development has had on in-school human resource capacity. Due largely to the system of local control of CPS schools, much of the initiative has stressed a top-down model of change (change flowing from district office to schools) as opposed to a bottom-up model of change (change emerging from within schools). In order to provide professional development to teachers, under circumstances
of limited resources, oftentimes training was provided to small sets of teachers who would then pass on their learning to larger groups of teachers within schools. This model created a middle tier of professional development providers, or trainers. Over the course of the CMSI, these professionals, many of whom were CPS teachers at one time or another, inhabited roles such as in-school specialists, coordinators, and coaches. In many cases, teachers left their traditional classroom duties to fill these roles. Thus, a question arises regarding the incentives provided to teachers who are trained in CMSI curricula to either stay in their classrooms and/or to move out of the classroom and into middle tier trainer positions. If teachers are not sufficiently provided with incentives to stay in their classroom positions, the initiative risks “culling the cream” and decreasing internal capacity within schools. As the initiative progresses one area of focus should be on how to cultivate teachers who are highly trained and skilled in CMSI curricula who will remain in their classrooms in order to increase in-school human resource capacity.

e. Logistics of scale up

Educational reform at the systemic level in Chicago engages the business units of the district and beyond—adding a whole new layer of complexity to already ambitious reforms. In section 3, we give examples of some of this complexity as reformers deal with purchasing procedures, contract negotiations, materials delivery and management, scheduling of rooms and facilities for meetings, union contracts and legal issues.

f. People and institutions

Since 2002, there have been major changes in leadership of various programs and in organizational structures. There has also been a degree of stability with many individuals staying within the system if not within the same role? How has this impacted the communication process? For example, OMS and OHSP? OHSP and IDS/HST? OMS evaluation and DoPE? Area and OMS? District and universities? Some contend that a key to sustainability of the Chicago reforms has been the trusting relationships between individuals. How have these relationships formed prior to and during reform efforts?

g. Density of universities

There are 17 four-year colleges or universities in the city limits of Chicago alone (according to the Carnegie Foundation http://www.carnegiefoundation.org/classifications). In March 2003, 67 representatives of 14 universities attended a planning meeting called by the district prior to the announcement of the Chicago Math and Science Initiative. How transportable is the systemic reform built around robust university-district partnerships to other school districts not situated in an area so rich with postsecondary institutions?
APPENDICES
   a. Evaluation Reports on Related Chicago Programs and Policies
      i. BY TYPE OF STRATEGIC ACTIVITY AND YEAR

Corresponding to Section 3 subsections
   3a. Curricular Materials that are Standards Based

2003-2004
Preliminary Descriptive Analyses: CMSI Intensive Support School First Wave Teachers Survey (Summer 03)
CMSI/CUSP Leadership Academy (Aug. 03)
CMSI/CUSP University-based Teacher Professional Development Courses (Aug. 03)
After School Math Professional Development Observations (Dec. 03)
CMSI Elementary School Instructional Area Math/Science Coaches (Dec. 03)
Chicago Mathematics and Science Initiative (CMSI) Preliminary Readiness Teacher Survey 2003 (Dec. 03)
Observations of CMSI Curriculum-Specific Professional Development Workshops, Summer 2003 (Feb. 04)
External Evaluation Memo: Feedback on What it Takes to Implement (Feb. 04)
OMS Facilitators and Staff Insights on Scale-Up (Feb. 04)
Perspectives on CMSI-supported Curricula: Comparing Backgrounds of School-based Instructional Leaders (April 04)
Chicago Teachers Project: Everyday Math Teacher Professional Development, January-June 2004 (June 04)


CMSI/CUSP Leadership: A Year after the Leadership Academy (Aug. 04)

2004-2005

*Algebra Problem Solving* Teachers Talk About Their Experiences, December 2004 (Jan 05)

Status of CMSI Elementary School Implementation: Considerations for OMS Budget Planning (Jan 05)

Chicago Teachers Project: The New Teacher Network at the Center for Urban School Improvement (Feb. 05)

Recommendations for the 2005-06 CMSI Strategic Plan for Elementary Schools: Resource Allocation Priorities (Feb. 05)

2005-2006

Evaluation of the CPS High School Two-Period Algebra Course, Fall 2005 (Feb. 06)

Seeking the “S” in CMSI: History and Implementation of the Science Initiative (Feb. 06)

Evaluation of the Developing Leadership to Sustain Change 2 Project, 2004-2005 (March 06)

Special Education Databrief (April 06)

CMSI Professional Development for Elementary School Staff (May 06)

Evaluation of the CPS High School Two-Period Algebra Course, Spring 2006 (June 06)

Supporting Content Coaching in Mathematics September 2005-May 2006 (June 06)

Chicago Teachers Project: Everyday Math Leadership Training, 2005-2006 (June 06)

Instructional Leaders Supporting CMSI Elementary Schools, Fall 2005 (June 06)

Implementing CMSI Math Curricula in Elementary Schools: A Three-Year Longitudinal Cross-Case Evaluation Study (Aug. 06)

2006-2007

Patterns and Prevalence in the Use of CMSI-Supported Curricula by CPS K-8 Teachers (Feb.07)
The Cluster 4 Middle Grades Project: Vignettes of 6 Schools (June 07)

2007-2008

How CPS Teachers Use, Teach, and Understand the CMSI-Supported Math Curriculum (Oct. 07)

Middle Grades Math and Science Instruction and Supports in Cluster 4 Project Schools (Jan. 08)

CMSI 8th Grade Algebra: Logistics, Structure, Instruction, and Professional Development (March 08)

A First Look at Variability in Teachers’ Math and Science Instruction and Curriculum Use (April 08)


Changes in Teachers’ Instructional Use of and Beliefs about the CMSI Curricula (Sept. 08)

External Evaluation of the OMS Professional Development Leaders Program, 2007-2008 (Oct. 08)
3b. In-Service Professional Development

2003-2004

Preliminary Descriptive Analyses: CMSI Intensive Support School First Wave Teachers Survey (Summer 03)

CMSI/CUSP Leadership Academy (Aug. 03)

CMSI/CUSP University-based Teacher Professional Development Courses (Aug. 03)

After School Math Professional Development Observations (Dec. 03)

CMSI Elementary School Instructional Area Math/Science Coaches (Dec. 03)

Chicago Mathematics and Science Initiative (CMSI) Preliminary Readiness Teacher Survey 2003 (Dec. 03)

Observations of CMSI Curriculum-Specific Professional Development Workshops, Summer 2003 (Feb. 04)

External Evaluation Memo: Feedback on What it Takes to Implement (Feb. 04)

OMS Facilitators and Staff Insights on Scale-Up (Feb. 04)

Specialist Reflection Summary (March 04)

Description of CMSI High School Initiative Goals, Components & Actors (March 04)

Perspectives on CMSI-supported Curricula: Comparing Backgrounds of School-based Instructional Leaders (April 04)


CMSI/CUSP Leadership: A Year after the Leadership Academy (Aug. 04)
CMSI/CUSP University-based Teacher Professional Development Courses (Aug. 04)

Chicago Teachers Project: Everyday Math Teacher Professional Development, January-June 2004 (June 04)

2004-2005

_Algebra Problem Solving_ Teachers Talk About Their Experiences, December 2004 (Jan 05)

Status of CMSI Elementary School Implementation: Considerations for OMS Budget Planning (Jan 05)

Chicago Teachers Project: The New Teacher Network at the Center for Urban School Improvement (Feb. 05)

Recommendations for the 2005-06 CMSI Strategic Plan for Elementary Schools: Resource Allocation Priorities (Feb. 05)

Recommendations for the 2005-06 CMSI Strategic Plan for Elementary Schools: Shaping the Roles of Staff Who Visit Schools in Support of Teachers Implementing Curriculum (Feb. 05)

Analysis of CPS Elementary Schools on Probation Implementing CMSI Curricula (April 05)

Chicago Teachers Project: Final Summative Report 2004-05 Grant (May 05)

2005-2006

Evaluation of the CPS High School Two-Period Algebra Course, Fall 2005 (Feb. 06)

Seeking the “S” in CMSI: History and Implementation of the Science Initiative (Feb. 06)

Evaluation of the Developing Leadership to Sustain Change 2 Project, 2004-2005 (March 06)

Special Education Databrief (April 06)

CMSI Professional Development for Elementary School Staff (May 06)

Evaluation of the CPS High School Two-Period Algebra Course, Spring 2006 (June 06)

Supporting Content Coaching in Mathematics September 2005-May 2006 (June 06)

Chicago Teachers Project: Everyday Math Leadership Training, 2005-2006 (June 06)

Instructional Leaders Supporting CMSI Elementary Schools, Fall 2005 (June 06)
Piloting Math Benchmark Assessments (June 06)

Implementing CMSI Math Curricula in Elementary Schools: A Three-Year Longitudinal Cross-Case Evaluation Study (Aug. 06)

2006-2007

Patterns and Prevalence in the Use of CMSI-Supported Curricula by CPS K-8 Teachers (Feb.07)

Evaluation of the Cluster 4 Middle Grades Project (March 07)

The Cluster 4 Middle Grades Project: Vignettes of 6 Schools (June 07)

2007-2008

How CPS Teachers Use, Teach, and Understand the CMSI-Supported Math Curriculum (Oct. 07)

Special Education Issues in CMSI Revisited (Jan. 08)

CMSI University-based Programs: Quality, Relevance and Support Toward Endorsement (Jan. 08)

Middle Grades Math and Science Instruction and Supports in Cluster 4 Project Schools (Jan. 08)

External Evaluation of the OMS Professional Development Leaders Program (Feb. 08)

CMSI 8th Grade Algebra: Logistics, Structure, Instruction, and Professional Development (March 08)

A First Look at Variability in Teachers’ Math and Science Instruction and Curriculum Use (April 08)


Teacher Experiences in CMSI University-based Math and Science Endorsement Programs, 2007-2008 (Sept. 08)

External Evaluation of the In-School Instructional Coaching Program: A Qualitative Study of the First Year of Implementation (Oct. 08)

CMSI Special Education Professional Development (July 08)

External Evaluation of the OMS Professional Development Leaders Program, 2007-2008 (Oct. 08)
3c. Human Resources Supports Strategy: Developing and Sustaining Mid-Level Supports for High Quality Math and Science Curriculum Use and Instruction

2003-2004

CMSI/CUSP Leadership Academy (Aug. 03)

CMSI Elementary School Instructional Area Math/Science Coaches (Dec. 03)

External Evaluation Memo: Feedback on What it Takes to Implement (Feb. 04)

OMS Facilitators and Staff Insights on Scale-Up (Feb. 04)

Specialist Reflection Summary (March 04)

Description of CMSI High School Initiative Goals, Components & Actors (March 04)

Perspectives on CMSI-supported Curricula: Comparing Backgrounds of School-based Instructional Leaders (April 04)

Issues Raised by Instructional Area Math Science Elementary Coaches at a CPS Office of Mathematics and Science Meeting on April 23, 2004 (May 04)

Chicago Teachers Project: Everyday Math Teacher Professional Development, January-June 2004 (June 04)


CMSI/CUSP Leadership: A Year after the Leadership Academy (Aug. 04)

2004-2005

Algebra Problem Solving Teachers Talk About Their Experiences, December 2004 (Jan 05)

Status of CMSI Elementary School Implementation: Considerations for OMS Budget Planning (Jan 05)
Chicago Teachers Project: The New Teacher Network at the Center for Urban School Improvement (Feb. 05)

Recommendations for the 2005-06 CMSI Strategic Plan for Elementary Schools: Resource Allocation Priorities (Feb. 05)

Recommendations for the 2005-06 CMSI Strategic Plan for Elementary Schools: Shaping the Roles of Staff Who Visit Schools in Support of Teachers Implementing Curriculum (Feb. 05)

Analysis of CPS Elementary Schools on Probation Implementing CMSI Curricula (April 05)

2005-2006

Evaluation of the CPS High School Two-Period Algebra Course, Fall 2005 (Feb. 06)

Seeking the “S” in CMSI: History and Implementation of the Science Initiative (Feb. 06)

Evaluation of the Developing Leadership to Sustain Change 2 Project, 2004-2005 (March 06)

Special Education Databrief (April 06)

CMSI Professional Development for Elementary School Staff (May 06)

Evaluation of the CPS High School Two-Period Algebra Course, Spring 2006 (June 06)

Supporting Content Coaching in Mathematics September 2005-May 2006 (June 06)

Chicago Teachers Project: Everyday Math Leadership Training, 2005-2006 (June 06)

Instructional Leaders Supporting CMSI Elementary Schools, Fall 2005 (June 06)

Piloting Math Benchmark Assessments (June 06)

Implementing CMSI Math Curricula in Elementary Schools: A Three-Year Longitudinal Cross-Case Evaluation Study (Aug. 06)

2006-2007

Patterns and Prevalence in the Use of CMSI-Supported Curricula by CPS K-8 Teachers (Feb.07)

Evaluation of the Cluster 4 Middle Grades Project (March 07)

The Cluster 4 Middle Grades Project: Vignettes of 6 Schools (June 07)

2007-2008

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How CPS Teachers Use, Teach, and Understand the CMSI-Supported Math Curriculum (Oct. 07)

Special Education Issues in CMSI Revisited (Jan. 08)

Middle Grades Math and Science Instruction and Supports in Cluster 4 Project Schools (Jan. 08)

A First Look at Variability in Teachers’ Math and Science Instruction and Curriculum Use (April 08)

CMSI Special Education Professional Development (July 08)

External Evaluation of the In-School Instructional Coaching Program: A Qualitative Study of the First Year of Implementation (Oct. 08)

Changes in Teachers’ Instructional Use of and Beliefs about the CMSI Curricula (Sept. 08)

External Evaluation of the OMS Professional Development Leaders Program, 2007-2008 (Oct. 08)
3d. Content Knowledge Depth in Math and Science for Teachers

2003-2004
CMSI/CUSP Leadership Academy (Aug. 03)

CMSI/CUSP University-based Teacher Professional Development Courses (Aug. 03)

Chicago Teachers Project: Everyday Math Teacher Professional Development, January-June 2004 (June 04)

CMSI/CUSP Leadership: A Year after the Leadership Academy (Aug. 04)

CMSI/CUSP University-based Teacher Professional Development Courses (Aug. 04)

2004-2005
*Algebra Problem Solving* Teachers Talk About Their Experiences, December 2004 (Jan 05)

Chicago Teachers Project: The New Teacher Network at the Center for Urban School Improvement (Feb. 05)

Chicago Teachers Project: Final Summative Report 2004-05 Grant (May 05)

2005-2006
Evaluation of the CPS High School Two-Period Algebra Course, Fall 2005 (Feb. 06)

2006-2007
Evaluation of the Cluster 4 Middle Grades Project (March 07)

2007-2008
CMSI University-based Programs: Quality, Relevance and Support Toward Endorsement (Jan. 08)

CMSI 8th Grade Algebra: Logistics, Structure, Instruction, and Professional Development (March 08)

CMSI 8th Grade Algebra: Logistics, Structure, Instruction, and Teachers and Their Preparation, 2007-2008 (Aug. 08)

Teacher Experiences in CMSI University-based Math and Science Endorsement Programs (Sept. 08)

External Evaluation of the OMS Professional Development Leaders Program, 2007-2008 (Oct. 08)
3e. Assessment Systems

2003-2004

CMSI/CUSP University-based Teacher Professional Development Courses (Aug. 03)

After School Math Professional Development Observations (Dec. 03)

Perspectives on CMSI-supported Curricula: Comparing Backgrounds of School-based Instructional Leaders (April 04)


CMSI/CUSP Leadership: A Year after the Leadership Academy (Aug. 04)

CMSI/CUSP University-based Teacher Professional Development Courses (Aug. 04)

2005-2006

Chicago Teachers Project: Everyday Math Leadership Training, 2005-2006 (June 06)

Instructional Leaders Supporting CMSI Elementary Schools, Fall 2005 (June 06)

Piloting Math Benchmark Assessments (June 06)

Implementing CMSI Math Curricula in Elementary Schools: A Three-Year Longitudinal Cross-Case Evaluation Study (Aug. 06)

2006-2007

The Cluster 4 Middle Grades Project: Vignettes of 6 Schools (June 07)

2007-2008

Middle Grades Math and Science Instruction and Supports in Cluster 4 Project Schools (Jan. 08)

CMSI 8th Grade Algebra: Logistics, Structure, Instruction, and Professional Development (March 08)
External Evaluation of the OMS Professional Development Leaders Program (Feb. 08)

A First Look at Variability in Teachers’ Math and Science Instruction and Curriculum Use (April 08)


Changes in Teachers’ Instructional Use of and Beliefs about the CMSI Curricula (Sept. 08)

External Evaluation of the OMS Professional Development Leaders Program, 2007-2008 (Oct. 08)
ii. **BY TYPE OF PROGRAM/POLICY AND YEAR**

Corresponding to Section 2 subsections

[Forthcoming listing of evaluation reports in this order]

iii. **AS LISTED ON CPS WEBSITE**

**Math and Science Education Evaluation Plans**
- 2005-2006 CMSI Evaluation Framework and Workplan
- 2004-2005 CMSI Evaluation Framework and Workplan
- 2003-2004 CMSI High School Programs Evaluation Plan
- 2004 After School and Summer School Programs Evaluation Plan Overview
- 2003-2004 After School Mathematics Program Evaluation Plan

**K-8 Mathematics and Science**

*Curriculum Implementation*
- External Evaluation Reports
- A First Look at the Activities and Roles of In-School Instructional Coaches (May 2008; 6 pages)
- CMSI 8th Grade Algebra: Logistics, Structure, Instruction, and Professional Development (March, 2008; 23 pages)
- University of Chicago & CPS Collaborative Approach: Math Teachers’ Support in the First Semester of 07-08 (April 2008; 20 pages)
- A First Look at Variability in Teachers’ Math and Science Instruction and Curriculum Use (April 2008; 13 pages)
- External Evaluation of the OMS Professional Development Leaders Program (February, 2008; 6 pages)
- CMSI University-based Programs: Quality, Relevance and Support Toward Endorsement (January, 2008; 9 pages)
- Middle Grades Math and Science Instruction and Supports in Cluster 4 Project Schools (January 2008; 8 pages)
- Special Education Issues in CMSI Revisited (January 2008; 5 pages)
- CMSI University-based Programs and Grade 8 Algebra, Fall 2007 Expectations (November, 2007; 4 pages)
- Curriculum Use in the Classroom Context: A Field Study of Teachers’ Math Instructional Practices and Rationales (August, 2007; 98 pages)
- The EnergyNet/Informing Ecological Design Project in Chicago Public Schools (August 2007; 14 pages)
- The Cluster 4 Middle Grades Project: The Experiences of Teachers (August 2007; 10 pages)
- Chicago Teachers Project: Everyday Math Leadership Training Project, 2007 (June 2007; 13 pages)
- Patterns and Prevalence in the Use of CMSI-Supported Curricula by CPS K-8 Teachers (February, 2007; 22 pages)
- Implementing CMSI Math Curricula in Elementary Schools: A Three-Year Longitudinal Cross Case Evaluation Study (August, 2006; 31 pages)
- Special Education Databrief (April, 2006; 10 pages)
- Recommendations on resource allocation (February, 2006; 2 pages)
- Recommendations on human resources and role development (February, 2006; 2 pages)
- Seeking the “S” in CMSI: History and Implementation of the Science Initiative (February, 2006; 22 pages)
- Instructional leaders supporting CMSI elementary schools, fall 2005 (January, 2006; 1 page)
- Instructional leaders supporting CMSI elementary schools, fall 2005 – Full Report (January, 2006; 39 pages)
- The EnergyNet Project in Chicago Public Schools (July, 2006; 22 pages)
- Chicago Teachers’ Project: Everyday Math Leadership Training 2005-2006 (June, 2006; 15 pages)
- Chicago Teachers’ Project: Final Summative Report (May, 2005)
- CMSI Professional Development for Elementary School Staff (May, 2006; 18 pages)
- Analysis of CPS Elementary Schools on Probation Implementing CMSI Curricula (April, 2005)
- Chicago Teachers’ Project: The New Teacher Network at the Center for Urban School Improvement (February, 2005)
- Recommendations for 05-06 CMSI Strategic Plan for Elementary Schools: Resource Allocation Priorities (February, 2005)
- Status of CMSI Elementary School Implementation: Considerations for OMS Budget Planning (January, 2005)
- Chicago Teachers’ Project: Everyday Math Leadership Training (September, 2004)
• CMSI/CUSP Leadership: A Year after the Leadership Academy (August, 2004)
• Chicago Teachers’ Project: Everyday Math Teacher Professional Development (June, 2004)
• Observations of CMSI Curriculum-Specific Professional Development Workshops (February, 2004)
• Feedback on what it takes to implement (February, 2004)
• CMSI/CUSP Leadership Academy, Summer 2003 (August, 2003)

**Developing CMSI Infrastructure**

• External Evaluation Reports
• Recommendations for 05-06 CMSI Strategic Plan for Elementary Schools: Shaping the Role of Staff who visit schools in support of teachers implementing curriculum (February, 2005)
• Perspectives on CMSI-Supported Curricula: Comparing Backgrounds of School-Based Instructional Leaders (April, 2004)
• OMS Facilitators & Staff Insights on Scale-Up of CMSI Elementary School Activities (February, 2004)
• OMS Facilitators & Staff Insights on Scale-Up of CMSI Elementary School Activities: Executive Summary and Chart (February, 2004)
• Issues Raised by Instructional Area Math Science Elementary Coaches (April, 2004)
• Specialist Reflections Summary (March, 2004)
• CMSI Elementary Instructional Area Math/Science Coaches (December, 2003)
• CMSI Preliminary Descriptive Analysis of Intensive Support School First Wave Teachers - Summer 2003 Survey Report (December, 2003)
• Lessons learned from OMS Leadership Academy (October, 2003)

**Early Childhood**

• Pre-K Everyday Math Field Test, 06-07 (March, 2008; 24 pages)

**Elementary Schools**

• Internal Evaluation Reports
• Characteristics of CPS Elementary School Teachers in the 2007-2008 School Year (April 2008)
• Characteristics of CPS Elementary School Teachers in the 2006-2007 School Year (January 2007; 31 pages)
• Characteristics of Chicago Public Schools Elementary School Math and Science Teachers in the 2005-2006 School Year (November, 2005)

**Coaching**

• In-School Instructional Coaching: Coaches' and principals' views of coach roles and activities (March 2008, 44 pages)
• Preliminary data from coaching written reflections (September 2007; 8 pages)

Assessment Development
• External Evaluation Reports
• Chicago Public Schools Mathematics Benchmark Assessment Pilot (Sept. 2006; in collaboration with Prof. Jim Pellegrino’s group at UIC)
• Piloting Math Benchmark Assessments (June, 2006; in collaboration with Prof. Stacy Wenzel’s group at UIC)
• The Curriculum-based Assessment Analysis (July, 2005; in collaboration with Prof. Jim Pellegrino’s group at UIC)
• Review of Assessments Contained in CMSI-Supported Curricula (July, 2004)

Algebra and Double Period Algebra

Two-Period Algebra (Algebra Problem Solving)

Internal Evaluation Reports
• Two Period Algebra: Final Report on Program Implementation and Participant Reactions in 05-06 (September, 2006)
• Two Period Algebra: First semester student outcomes in the 2005-2006 School Year (April, 2006)
• Two-Period Algebra Memo: Teacher Survey Results (May, 2006)
• Two Period Algebra: Memo on first and second classroom observations (March, 2006)
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• Two Period Algebra - School Year 05-06 (June, 2006)
• Two Period Algebra - Roles Report (February, 2006)
• Algebra Problem Solving Teachers Talk about their Experiences (January, 2005)

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• 2005-2006 Algebra Progress Reports (January 2007, 1-page/each elementary school)
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• Relationship Between 8th Grade ITBS Scores and 9th Grade Algebra Performance (June, 2004)
• Multi-Year Analysis of the Bulls Scholars Algebra Program (May, 2004)

High School—General

Internal Evaluation Reports
• Characteristics of Chicago Public Schools High School Math and Science Teachers in the 2005-2006 School Year (Available Fall 2006)
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• High School Math and Science Textbook Inventory (December, 2003)
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• Step Up: Results from the Student Survey (September 2006)
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• Step Up Planner's Report, Summer 2005 (December, 2005)
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• Step-Up Planner’s Report, Summer 2004 (December, 2004)
• Step-Up Teacher’s Report, Summer 2004 (October, 2004)
• Estimating Step-Up to High School Eligibility (December, 2003)

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• Observations of CMSI After School Professional Development (February, 2003)
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• Chicago Public Schools’ University-Based Programs and Participant Credentialing: Preliminary indications of outcomes for teachers (January 2007; 46 pages)
• CMSI-University Courses Program: Preliminary Indications of Participant Credentialing (March, 2006)
• CPS and University Partners Program – Action Research Analysis (April, 2005)

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• CMSI/CUSP University-based Teacher Professional Development Courses (August, 2004)
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• NSF Annual Report of Progress Sept. 1, 2004 - Aug. 31, 2005
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• NSF Core Data Elements Report, 2006
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• NSF Core Data Elements Report, 2004
• 2003 Basic District Wide Data

Presentations and Conference Papers
2007 American Evaluation Association
• Think Tank submission: What have we learned from/what do we still need to learn about developing evaluation organizations?
2007 American Education Research Association

- Paper Submission: Benchmark Assessment Results in Context: Case from Chicago Public Schools
- Paper Submission: Finding Time for Inquiry and Reflection: Chicago Mathematics and Science Initiative Challenges and Successes

2006 American Evaluation Association Conference

- Paper Submission: Addressing Stakeholder Needs Using a Mixed Method Design
- Powerpoint Presentation: Engaging Evaluators & Client around Findings: Tracking Changes in Communication
- Powerpoint Presentation: Formative Evaluation at its Finest: A Historical Analysis of Evaluation Reports
- 2006 8th Annual Chicago Symposium Series - Excellence in Teaching Mathematics and Science: Research and Practice
- Powerpoint Presentation: Chicago Public Schools' University-Based Programs and Participant Credentialing: Preliminary indications of teacher outcomes

2006 American Education Research Association

- Paper Submission: The kiss of the dementor or the breath of life: School-level sense making and the implementation of an elementary math initiative
- Paper and PowerPoint: Increasing Experienced Teachers’ Math and Science Content Knowledge: Evaluating the Partnership Approach of One Large Urban District and Area Universities

2005 American Evaluation Association Conference


2004 American Evaluation Association Conference


2004 Invitational Urban Indicator Data and Evaluation Workshop


Other Dissemination

• “Talking with Teachers: School-University Partnerships”, B. Feranchak, R. Shefner, and B. Saunders, Mathematicians and Education Reform Forum Newsletter: Algebra Initiative Special Issue (Spring 2005, Volume 17, Number 2, pp. 8-9).
• ‘Preliminary Evaluation Results from the Chicago Mathematics and Science Initiative”, B. Feranchak, University Chicago School Mathematics Project Newsletter (Winter 2005-06, No. 34, pp. 3-8).
b. Public Documents Related to Chicago Programs and Policies

This section is under construction. For questions and suggestions, contact swenzel@luc.edu.
c. Stories, Vignettes, and Video-Clips

This section is under construction. For questions and suggestions, contact swenzel@luc.edu.
d. Authors and Contributors

The process of creating this document has engaged many people. The authors listed have done the intensive writing shaping this document during the 2007 to 2009 period with the support of a NSF DRK-12 grant. However most of the findings about which they wrote were collected, compiled and initially analyzed between 2002 and 2007 by the authors with the assistance of evaluation research teams with whom they worked. Further, the shape of this document was also influenced by a team of collaborators during 2007 to 2009 who read early drafts and dialogued on the facts and format of this paper. Here we give some information about the authors and many thanks to the others who have contributed. We also invite the readers of this document to contact us with their verbal and written feedback on this work. We hope to add to this document -- using it to future dialogue on systemic reform of math and science education.

i. Authors

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Janise Hurtig is a co-director of UIC PRAIRIE. She received her Ph.D. in Anthropology from the University of Michigan and has been an educational researcher and program evaluator at UIC since 1998. Dr. Hurtig currently directs several evaluation projects with CPS offices, including projects focusing on program development, logic modeling, and internal evaluation design. She has published in the areas of youth and adult education, literacy, participatory action research and evaluation, gender, and social change in Latin America and the urban United States.

Rachel Shefner is the founding co-director of Loyola's Center for Science and Math Education. A faculty member in the Natural Science Department, she currently directs projects supporting teacher professional development in science and math education. Shefner oversees LUCSME’s SEPUP Implementation Center, which has supported CPS teacher professional development in the SEPUP curricula since 2003. Through this work and work on the Gates-funded CPS High School Transformation Project, Shefner has demonstrated an understanding of the evolving processes
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Stacy Wenzel is PI on the DRK-12 grant supporting this work. She has been lead external evaluator of the CMSI since September 2002 and is an associate research professor at Loyola University Center for Science and Math Education. She has been conducting evaluation of STEM education projects for the past 18 years and has focused her work on the Chicago area since 1995. Wenzel has been principal or co-principal investigator on several research grants funded by the National Science Foundation and has also served as external evaluator on other NSF-, state-, city- and private foundation-funded projects aimed at improving math and science education for urban public school students. Her research interests and publications focus on equity in and systemic reform of science, math and engineering education at the postsecondary and K-12 levels. A former industrial process engineer, she has a BS in chemical engineering from the University of Notre Dame and a PhD from the University of Michigan-Ann Arbor Center for the Study of Higher and Postsecondary Education.

ii. 2007 – 2009 Contributors

In July 2008, a two-day Summit was convened to discuss the nature of systemic reform of Chicago K-12 education and participants at this working meeting read and discussed an earlier draft of this paper. Their comments were immensely valuable. In addition to the paper authors noted above, this group included:

- Jeannette Bartley, CPS Office of Math & Science
- Marty Gartzman, UIC Office of the Provost
- Andy Isaacs, U Chicago CEMSE
- Mike Lach, CPS Dept of High School Teaching & Learning
- David Mayrowetz, UIC Education Policy Studies
- Steve McGee, Northwestern U, Education & Social Policy
- Lynn Narasimhan, DePaul U, Liberal Arts & Sciences
- Kelci Price, CPS Department of Program Evaluation
- Mary Jo Tavormina, CPS Office of Math & Science.

Additional insights were contributed when the authors worked intensely with Narasimhan and Mayrowetz and with Chandra James, Director of CPS Office of Math and Science, to shape a research grant proposal to DRK-12 in January 2009. The paper also benefited from thoughtful editing and feedback from Claudine Daubenmire. Further credit for this work goes to the directors of the CPS Office of Math and Science who over the years documented their programs and who
welcomed and supported and shaped the evaluation efforts on which this paper draws. These directors are James (2007-present), Lach (2006-2007), and Gartzman (2002-2006).

### iii. Thanks to Evaluation Teams

Data considered for this paper were collected and analyzed primarily by the authors and the teams of evaluators with whom they worked during 2002 to 2008 at their institutions of the UIC PRAIRIE Group, CPS Office of Math and Science and Department of Program Evaluation, and Loyola University Chicago Center for Science and Math Education. Members of these teams included (in alphabetical order):

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- Jessica Lent
- Jonya Leverett
- David Mayrowetz
- Mariam Mazboudi
- Esther Mosak
- Gregg Mossberger
- Isabel Nunez
- Kelci Price
- Lisa Raphael
- Sara Stoelinga
- Rose Sweeney
- Geen Tomko
- Lois Trautvetter
- Erika Vogele
- Jianying Yan

### iv. Thanks to Teachers and Administrators Sharing Insights with Evaluators

Most importantly, this document owes its existence to the thousands of teachers and administrators at schools and universities who have spoken during interviews, allowed their meetings and classrooms to be observed, filled in surveys, written reflections and shared documents with evaluation teams from 2002 to 2008. These educators have been incredibly thoughtful, candid and generous in allowing us to view the workings of Chicago’s math and science education community.
e. Other

[Forthcoming on additional detail on late 1990s and early 2000s contextual data around student achievement in math and science in CPS schools]

This section is under construction. For questions and suggestions, contact swenzel@luc.edu.
5. REFERENCES

[Forthcoming – this section needs to be completed and edited]


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