

Integrating Curriculum Guides,  
Quarterly Benchmark Assessments,  
and  
Professional Development to  
Improve Student Learning in Mathematics

by

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Abstract

In this study teachers in a large urban school district in southern California used standards-based curriculum guides, quarterly benchmark assessments, and focused professional development to improve the achievement of their students in math content as measured by the California Standards Test in mathematics and reported as part of each school's Annual Yearly Progress. The average growth of the students in mathematics far out-paced their growth in English Language Arts as well as the average growth for students in the county and the state in mathematics. The findings support a three-pronged approach that consists of curriculum guides that organize and pace the content standards and include model tasks for student outcomes supported by standards-based quarterly benchmark assessments which give the teachers timely feedback about student conceptual understanding of the standards. Even greater growth is seen from students whose teachers attend research-based professional development.

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In the 1980s and particularly in the 1990s, educational reform focused on the development of standards that called for higher levels of performance in content areas to be demonstrated by students and educators and supported by school districts. The rationale for rigorous standards was that these would promote quality curricula and effective teaching, which would, in turn, translate into enhanced learning and achievement for all students. One intent of establishing rigorous standards was to narrow the achievement gap separating minority students from students who were native English speakers (LaCelle-Peterson & Rivera, 1994). Yet, as Barton (2004) contended, even though larger numbers of minority students are taking more rigorous courses, there has not been the narrowing of the achievement gap that one would expect from increased advanced course taking. For the last ten years, the achievement of African-American and Latino students has not shown substantial gains (National Study Group for the Affirmative Development of Academic Ability, 2004).

As a more systemic approach to closing achievement gaps and improving learning for all students, the National Study Group for the Affirmative Development of Academic Ability (2004) suggested access to a combination of educational interventions in the classroom, school, and community. They recommended applying proven pedagogical practices to help student learning, establishing more supplementary learning opportunities, helping teachers master their subjects, providing challenging academic work for students, and using instructional methods that build on what students already know. The literature supporting this recommendation has a common theme in the recognition of standards as a critical component of successful practice. For example, Tucker and Coddling (1998) described a standards-based classroom as one that has explicit indicators of quality work, what Phil Daro called a “quality triangle”: standards-driven content of instruction, student outcomes, and assessment of student work. Further, O’Shea

(2005) agreed that more than standards are needed to improve student achievement. He outlined a coordinated plan that included not only standards-based lessons but also curriculum pacing guides with explicit student learning outcomes, district-wide benchmark testing that correlate to statewide standards assessment, and professional development for teachers in the content of the standards.

O'Shea's plan echoes the current emphasis on more rigorous assessment and accountability as another important aspect of education reform that is integral to the use of standards. As Shepard (2000) had earlier contended, assessment reform is part of the larger effort to raise standards for classroom instruction and improve the quality of education: "what you test is what you get" referring to the effect large-scale assessments have on school curriculum. Shepard (2000) proposed that classroom assessments must match "challenging subject matter standards and be connected to contexts of application (p. 31)." Assessments must be linked to classroom instruction that promotes conceptual understanding. Until recently, however, this integration has not been possible for many low performing students. English Learners (ELs) were exempt from large-scale assessments but their inclusion is now mandated so that a more accurate picture of overall student achievement and growth will result (Abedi, 2001). The "No Child Left Behind" legislation mandates testing of every child every year. The Commission on Instructionally Supportive Assessment (2001) recommended that:

A state must ensure that all students have the opportunity to demonstrate their achievement of state standards; consequently, it must provide well designed assessments appropriate for a broad range of students, with accommodations and alternate methods of assessment available for students who need them. (p. 5)

Beyond the need for rigorous standards and assessment and accountability are the findings of Elmore (2002), Gandara, Maxwell-Jolly, and Driscoll (2005), Darling-Hammond (1999), and O'Shea (2005) who advocated for focused professional development of teachers as a means of improving student performance. Elmore (2002) stated that increasing student achievement depended on "improving teachers' 'capacity' (the knowledge and skills of teachers)--changing their command of content and how to teach it--and helping them to understand where their students are in their academic development. . . You can't improve a school's performance, or that of any teacher or student in it, without increasing the investment in teachers' knowledge, pedagogical skills, and understanding of students (p. 36)." O'Shea (2005) echoed this idea in proposing that curriculum guides and instructional resources are helpful, but it is prepared teachers making informed planning decisions in their classrooms that improves student learning.

Mathematics is the targeted curriculum for the present study, and the form of professional development for this study has been adapted primarily from Guskey (1986) and Loucks-Horsley, Hewson, Love, and Stiles (1998). To facilitate sustained and significant educational improvements, the Guskey model of professional development incorporates the explicit means of communicating instructional goals. In the case of this study, the goals were specific pedagogical techniques woven into content standards and aligned to the curriculum guides. The use of manipulatives to address higher-level relational and conceptual knowledge facilitated teacher learning in concrete, rather than abstract terms. The research of Loucks-Horsley, Hewson, Love, and Stiles (1998) suggests that professional development that affects change must be on-going, rigorous and focused. An intent of the professional development provided as part of this study was to create teacher leaders who would receive at least 80 hours of professional development a

year while acquiring the skills necessary to assist in the delivery of professional development both at their school site and within their district.

### *Purpose of this Study*

The purpose of this study was to determine if a three-pronged intervention of well-written, standards-based curriculum guides combined with quarterly assessments and professional development could assist teachers from a low-performing school district to increase student achievement in math.

### Method

The study consisted of a three-pronged alignment: alignment of scope and sequence of curriculum guide to standards; alignment of curriculum and classroom instruction to assessments and alignment of professional development for teachers to the content standards applied to mathematical education in a K-12 district with a large inclusion of EL learners and low income families.

### *Participants*

The participants in this study consisted of all 788 teachers in self-contained classrooms, grades K-6, as well as 86 math teachers in grades 6-12 from a large urban unified school district in southern California along with their 10,621 respective students. The school district, designated as a “Program Improvement District”, has a diverse student population that is 68.8% Hispanic, 29.2% African American and 2 % other ethnicity. Ninety-five percent of the student population receives free or reduced lunch and 58.8% of the student population are designated as English Language Learners. The teachers represent equally diverse backgrounds, with 4% Asian, 6.6% Filipino, 20% Hispanic, 44.3% African American, 23.3% White and 1.8% other. Just 50.2% of teachers are fully credentialed, as compared with 91% for the state of California.

This district received no other interventions for math curriculum or content delivery other than the program being reported in this report. An analogous program for enhancing science content and pedagogy is currently being developed and will be the subject of separate reports.

In this large urban school district, as in the rest of the State of California, the State Mathematics Content Standards, adopted in 2000, are the curriculum for grades K-12 as well as the basis for the California Standards Test (CST) given to students in grades 2-11. Prior to this study, district teachers had been using state-adopted textbooks as the sole resource in their attempts to teach the standards. As O'Shea (2005) noted, nationally marketed textbooks do not serve as effective pacing guides for an individual state's standards; therefore, curriculum guides were a necessity for the teachers. Given the review of the literature, it was deemed critical to provide teachers with a means of assessing their pupils' achievement of the standards being taught, and professional development opportunities for mastering the content and optimal pedagogical practices. Thus, the approach was three-pronged: content curriculum guides, benchmark assessments and professional development. They were implemented as follows.

### *Phase 1*

During the summer of 2003, teacher leaders from the school district met with the Co-Directors of the University of California, Irvine Math Project to begin drafting curriculum guides for the district. These guides were written based upon the standards and then aligned to the district-adopted math textbook. The first step was to determine the order of standards to be taught as well as the grouping of standards to be taught. Standards were organized into topics and allotted a certain number of weeks for instruction. Pacing of the standards was aligned with the CST blueprint for each strand (Number Sense, Algebra & Functions, Measurement & Geometry and Statistics, Data & Probability), where applicable. For each standard, model tasks

were also written into the curriculum guides. These are performance objectives that indicate a student's level of mastery of a particular standard. Along with model tasks, teaching resources were included--textbook lessons, alternative teaching strategies, literature books and lessons offered by the Irvine Math Project through professional development, all of which could be used by teachers in their attempts to teach the standards. Each unit (set of topics) also had an opening activity to allow a teacher to assess prior knowledge, as advocated by the National Research Council (2000, 2005). Model tasks were coded when they included strategies recognized as effective for teaching English Language Learners, such as Graphic Organizers, Direct Modeling, Sentence Frames, or Chants. Each page of the guide also contained a textbook reference indicating key vocabulary as well as materials needed for that particular unit(see Appendix B for a one-page sample). Lastly, each guide had a page containing a list of textbook lessons that did not address particular grade level standards as well as a list of standards not covered or not sufficiently covered within the adopted textbook.

Curriculum guides were initially introduced to elementary school administrators in August 2003. In late August, the Irvine Math Project provided trainings for grade level representatives selected by school site administrators. However, this training was poorly attended (only 4 schools out of 33 sent representatives). Copies of the guides were sent out to each school, with fewer than half actually finding their way into the hands of the classroom teachers. Therefore, a second, more comprehensive training was held in October 2003 for elementary school representatives in addition to a secondary (grades 6-12) administrator training.

Over the course of this first year of implementation, professional development courses were offered by the Irvine Math Project. These courses were attended by 100 elementary school teachers in the form of 40-hour workshops in August 2003. These workshops focused on

pedagogy woven into content in the form of activities for teachers to incorporate into their teaching. These activities were outlined in the guides. During the academic year, other release day professional development included an additional 30 elementary school, 30 middle school and 30 high school teachers who received instruction in using classroom materials to promote conceptual understanding of the standards.

Quarterly assessments were written by the Irvine Math Project and distributed in early November 2003 for administration in every classroom. Each assessment was multiple-choice format, ranging from 8 to 18 questions. Questions were modeled after the CST released items and based on the pacing of the standards as set forth in the curriculum guides. A software program (Classroom Administrator) was used to analyze results. All teachers gave the assessments and returned the exams to the district research and evaluation department. Results were distributed to teachers within a 6 month period both as the total number of items correct and as a breakdown by class of standards mastered. The same process was repeated for each of the next three quarters; however, 4<sup>th</sup> quarter assessments were not used by many schools.

In May 2004, grade level representatives again met to review the successes and failures of the guides, as perceived by their teachers. Following this meeting, the associate superintendent decided to make revisions to the guides, based upon these pilot experiences.

### *Phase 2*

Approximately 4 teachers from each grade level, selected by their school site administrators, met with the Irvine Math Project in June 2004 to revise the curriculum guides. Revisions included adjusting pacing, making the format more user-friendly, outlining the standards to be covered on each quarterly assessment and adding additional, supplemental resources. In addition, for the elementary grades, a second resource textbook was included, as

teachers were struggling to teach many of the state content standards not supported by their book.

The revised guides were copied, shared again with administrators, and distributed to all teachers. New quarterly assessments were written for the 2004 - 2005 school year, maintaining the format of the Phase 1 assessments. This time results from the assessments were received by administrators and teachers within one week of their administration. Some elementary schools used time set aside during “Early Release Mondays” to analyze and discuss test results as a staff.

In the summer of 2004, 40-hour professional development sessions were offered to teacher leaders representing 21 of the 24 elementary schools, 2 of the 8 middle schools and 1 of the 4 high schools. In addition, sets of 5 release days were offered to 80 teachers in grades 3-5 and 20 teachers in grades 6-9 during the academic year. Teachers self-selected to attend these institutes and represented approximately 60% of the schools. A typical 8-hour session included 1.5 hours for the reading and discussion of research related to current educational reform, 1 hour for the analyzing of standards, the curriculum guides and the quarterly benchmark results and the remainder of the day being devoted to engaging mathematical investigations to support both content and pedagogy.

Primarily constructivist, the professional development guided participants to construct their own understanding of mathematics, the learning being more internalized because the participants negotiated its meaning. The intent of professional development offered through the Irvine Math Project was to lead teachers in activities that allowed them to discover the “why” of the mathematics they teach, what Shulman (1986) called subject-matter content knowledge (not only *that* something is so but also *why* it is so). This was accomplished by preparing investigations which used modeling or manipulatives and incorporated inquiry to lead the teacher

to understand the underlying mathematics. It is the hypothesis of the Irvine Math Project that teachers are unable to guide their students to understand the mathematics if they, themselves, do not fully understand it.

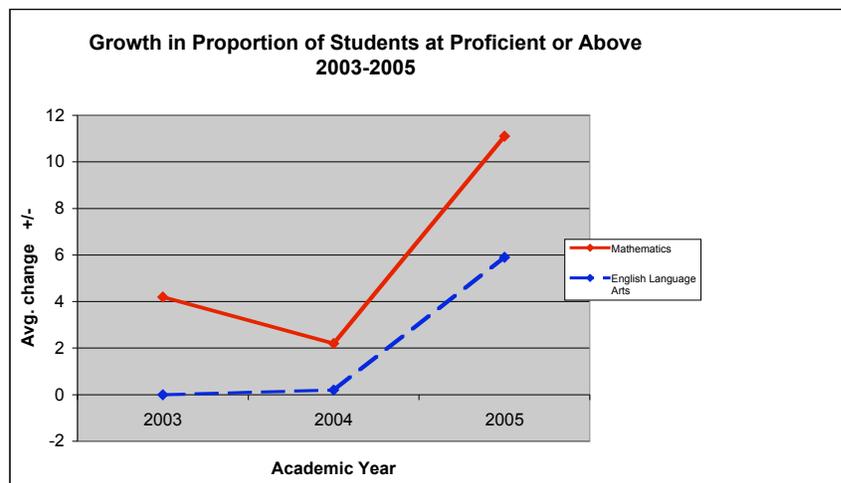
If a visitor were to walk into a professional development session, he/she could expect to see teachers working in groups of 3-5. The majority of the discourse would be taking place within the groups, as participants collaborate to work through mathematical investigations. Participants would also be in the front of the room, sharing their solutions and different ways of thinking. The leader of the professional development would be seen asking questions of the teachers in an attempt to push them in their thinking or to help them see connections. After each 45 minute to 1.5 hour investigation, the facilitator of the professional development session would be sure to summarize results, and lead a discussion of what standards were addressed and how this activity could be modified to be more successfully implemented in the classroom. Time would also be spent identifying where the particular activity fit into the curriculum guide and how much time would need to be allotted for mastery of the standard.

The activities done in professional development focused on concepts and relational knowledge. Little time was spent on how to teach facts and procedures, as this is what the teachers already did and what the textbooks presented. Furthermore, the activities done in professional development were meant to replace or supplant textbook sections. Because of the belief of the Irvine Math Project that successful math learning is marked by students first understanding concepts before they are given rules or algorithms, participants were encouraged to allow their students to invent their own algorithms after having used manipulatives or drawings to solve problems. Participants were taught how to engage their classes in mathematical discussions, placing great emphasis on different methods or solutions.

During professional development, participants spent time looking through student work and were taught to analyze the work to inform their teaching. Teachers were encouraged to regularly incorporate student error into their teaching and create an environment where students feel safe sharing their solutions and thinking.

### Results

Growth in student performance was analyzed by student achievement, based on the CST<sup>1</sup>. The CST is given to all students, grades 2-11, and is based solely on the California Content Standards. Students are placed into one of five categories, based upon their performance on this exam: Far Below Basic, Below Basic, Basic, Proficient or Advanced. The school district showed a non-significant drop between 2003 and 2004, followed by an overall 9% growth in students achieving Proficient or Above in mathematics on the CST for the 2004 school year. English Language Arts was flat in 2003-2004 but grew by 6% in 2004-2005 (see Figure 1).

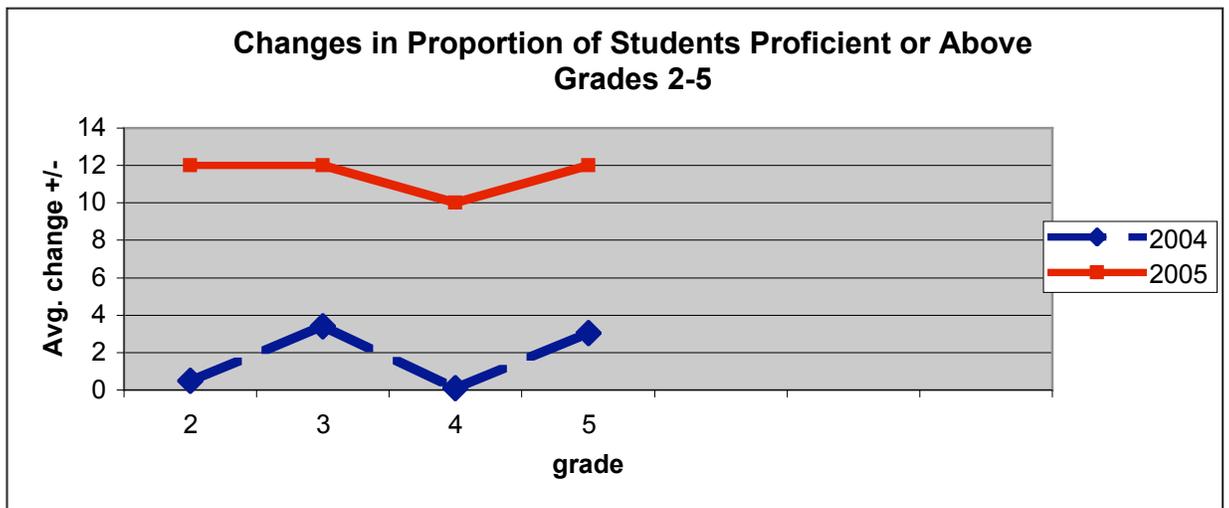


**Figure 1**

<sup>1</sup> In looking at student achievement, this study examined only the percent of students who had achieved at the Proficient or Advanced levels as these are the ones that determine whether the schools in the district have attained the Annual Yearly Progress (AYP) mandates by the No Child Left Behind legislation. Students also advanced from below basic to basic levels, but since this is not part of the AYP, this study chose to ignore that data. For the same reason, this study only looked at student achievement in challenging courses: Algebra I for grade 8, Geometry for grade 9, and Algebra II for grade 10.

Inspection of Figure 1 will reveal that, for all three years 2003 - 2005, the same population of students was able to achieve at a higher level in Mathematics than in English Language Arts with almost double the level of achievement in the 2005 CST relative to prior years. An Effect Size of 0.60 indicates that the mean student achievement in Mathematics is at the 73rd percentile of the student achievement in English Language Arts and that there is 38.2% percent of non-overlap of the treated group's scores with those of the untreated group.

When this data is disaggregated by grade level for grades 2 - 7, there are consistent increases for the 2005 CST compared to 2003 CST (see Figure 2) ( $F(2,99) = 49.127, p < .001$ ). A series of paired t-tests reveal that the changes in 2003-2004 are non-significant ( $p > 0.1$ ), while the changes in 2004-2005 are significant (see Table 1).



**Figure 2**

Elementary students showed greater growth than secondary. The greatest growth from 2004-2005 took place in 3<sup>rd</sup> grade mathematics, where the average percent of students moving to Advanced or Proficient was 13%. The 2<sup>nd</sup> and 5<sup>th</sup> grade students showed a 12% average growth

in movement up to Advanced or Proficient, where the growth for middle and high school students fell to non-significant levels (see Table 1).

**Table 1**

**Growth in Percent of Students Achieving Proficient or Advanced, 2004-2005**

<b>Grade Level</b>	<b>Number of students</b>	<b>Number of Schools</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>P value</b>
2 <sup>nd</sup>	2725	24	12%	11	.000
3 <sup>rd</sup>	2903	23	13%	15	.000
4 <sup>th</sup>	2768	23	10%	12.96	.001
5 <sup>th</sup>	2881	24	12%	16.68	.001
6 <sup>th</sup>	2592	9	7%	5.17	.01
7 <sup>th</sup>	2629	9	1%	4.4	NS
8 <sup>th</sup> Algebra I	1519	8	2%	16	NS
9 <sup>th</sup> Geometry	275	3	1%	1.53	NS
10 <sup>th</sup> Algebra II	254	3	1%	4	NS

The two-tailed paired samples t- test for grades 2 to 6 showed significance at  $p \leq .001$ . The growth varied from school to school with one school's students improving by as much as 42.8%. (see Appendix A). Of particular interest is the 8<sup>th</sup> grade Algebra I result, where one school grew in Proficient or Advanced by 20% while another decreased by 21%. The district leadership attributes the school's sharp decline to school-site autonomy in that the middle schools had decision making control over which students took an Algebra I course and test. In particular, the school demonstrating the large decrease in achievement is one whose student population was given the Algebra I test without having completed the Algebra I curriculum.

Of the 24 elementary schools, 20 schools (83%) met their school-wide AYP target in 2005 for mathematics, whereas only 6 schools (25%) met criteria in English Language Arts (see Appendix A). The percent of students scoring at the Proficient or Advanced level has grown from an average 21.2% in 2002 to 38.4% (17.2% total growth) in 2005 in mathematics, as compared to a growth from 13% in 2002 to 23% (10% total growth) in 2005 for English Language Arts. One elementary school increased its AYP from 20% in 2002 to 82% in 2005.

The top growth (2004-2005) for an individual school site and grade level took place at an elementary school whose 5<sup>th</sup> grade students demonstrated a 51% increase in those scoring Proficient or Advanced.

For 2004 -2005 the school district's growth in students achieving Proficient or Advanced scores in mathematics exceeded growth of both the State and the County at all levels except for grades 7, 9, and 10. (see Table 2). The average growth in the State for grades 2-5 students achieving Proficient or Advanced in mathematics was 4.75% as compared with 11.75% growth in the school district. Similarly, the county of Los Angeles showed an average growth of 5% for grades 2-5 compared with the district's 11.75% growth. The growth of 2<sup>nd</sup>, 3<sup>rd</sup>, and 5<sup>th</sup> grade students moving to Proficient or Advanced in the school district was more than twice the growth for the state. In 4<sup>th</sup> grade, the percent of district students scoring Proficient or Advanced grew 5 times as much as the state. Likewise, the school district exceeded LA county growth by a factor of 4 for 2<sup>nd</sup> grade and a factor of 2 or greater for grades 3-5. By comparison, the average growth for grades 2 - 5 in English Language Arts was 4.5% in the school district, where the averages for the state and county were 4.75% and 4%, respectively. Thus the relative gains in growth that we have observed in Table 2 appear specific to mathematics achievement, the subject matter targeted by our intervention.

**Table 2**  
**2004-2005 Growth in Students Achieving Proficient or Advanced: State, County and District**

Grade Level	State of California	Los Angeles County	Unified School District
2 <sup>nd</sup>	5%	3%	12%
3 <sup>rd</sup>	6%	7%	13%
4 <sup>th</sup>	2%	5%	10%
5 <sup>th</sup>	6%	5%	12%
6 <sup>th</sup>	5%	5%	7%
7 <sup>th</sup>	4%	5%	1%
8 <sup>th</sup> Algebra I	-1%	-3%	2%
9 <sup>th</sup> Geometry	4%	0%	1%
10 <sup>th</sup> Algebra II	3%	2%	1%

The students of the 10 teacher leaders in grades 2-5 who consistently attended professional development averaged 58% Proficient or Advanced on the math CST (2005) as compared with 34% Proficient or Advanced for the district. Some of the achievement levels of students whose teachers participated in sustained professional development exceeded the district levels of Proficient and Advanced by 50% or more (see Table 3).

**Table 3**  
**Percent of Students Achieving Proficient or Advanced (2005) for Teachers Consistently Attending Professional Development**

Teacher	Grade Level	Percent of teacher's students at Proficient or Advanced	Percent of students Proficient or Advanced district-wide for that grade level	Percent of teacher's students exceeding their grade level averages for Proficient and Advanced
Teacher A	2 <sup>nd</sup>	52%	47%	5%
Teacher B	2 <sup>nd</sup>	85%	47%	38%
Teacher C	3 <sup>rd</sup>	61%	38%	23%
Teacher D	3 <sup>rd</sup>	50%	38%	12%
Teacher E	3 <sup>rd</sup>	86%	38%	48%
Teacher F	3 <sup>rd</sup>	89%	38%	51%
Teacher G	4 <sup>th</sup>	12%	28%	-16%
Teacher H	4 <sup>th</sup>	42%	28%	14%
Teacher I	5 <sup>th</sup>	19%	24%	-5%
Teacher J	5 <sup>th</sup>	79%	24%	55%

## Discussion

This report represents the first formal evaluation of a three-pronged mathematics educational intervention in a low-performing 'Program Improvement District' in Southern California where many ELL and low income students reside. As of 2005, the combined implementation of curriculum guides, quarterly assessments and professional development of teachers has coincided with a 12% gain in student achievement. The schools district has been showing a trend towards positive gains, but the mathematics gains are approximately 33% greater than growth in Language Arts. Moreover, the gains in mathematics are nearly 140% of the 5% gain seen in the state and other parts of Los Angeles County. No such gains were seen in English Language Arts, where the district slightly underperformed the state and county.

The overall increase in student mathematics achievement in 2004-2005, particularly at the elementary level, was significant. The successful implementation of curriculum guides, quarterly assessments, and professional development led to growths of up to 64% at one grade level over the two-year implementation. The teachers and pupils in 2003-2005 had the same mathematics textbooks and resources available to them during this time as they did before intervention began. The coincidence of these gains and the implementation of the three-pronged intervention seem to be an indication of success, and other attempts to tie the level of success to specific dosages of professional development and the fidelity of implementation of the content standards and quarterly benchmarks are being pursued. In the three sections below is a post hoc review of some of our experiences in each innovation as well as speculations on how these may have played key roles in the performance gains documented.

*Curriculum Guides*

A case can be made that the curriculum guides successfully contributed to increased student achievement because they offered three things: a form of pacing, model tasks with explicit student performance outcomes, and suggested alternative teaching strategies. It is our impression that effective curriculum guides must not only provide guides for pacing the teaching of the standards and align the textbook to those standards, but they also must contain well-written model tasks and teaching strategies that will work for both a novice and veteran teacher. Teachers need model tasks to have a clear picture of what students should be able to do in demonstrating competency within a standard. Furthermore, successful curriculum guides will be dynamic, in the sense that the teachers using the guides are able to give input each year and add additional resources they have gained through education or professional development (O'Shea, 2005).

Curriculum guides must be standards-based and assist teachers in learning how to use the adopted textbook as a resource. Whereas adopted text materials will have many lessons for review or advancement, the curriculum guides must map out instructional time so that key standards are given sufficient time and all standards are addressed. A teacher whose students have mastered their grade level standards, as evidenced by proficiency on the benchmark exams, may find other text lessons useful; however, as demonstrated in the TIMSS study (Schmidt, 1995), successful math classrooms cover fewer topics in greater depth. Therefore, the curriculum guides should suggest enrichment activities that can allow a student greater depth of understanding of a standard. Since the guides are aligned to the standards, rather than one textbook, they should be a document that is used well beyond the current text adoption. If new

resources come into a district, they should be added to the guide, but not necessitate a major change in the guides.

In comparing the greater growth in student achievement of the elementary schools with that of the middle and high schools in this Unified School District, two major explanations occur to us. First, in all intervention studies, it may take a few years for the secondary schools to show significant improvement, as many of the elementary school students are now learning the standards for the first time and a pipeline must be created. Therefore, as elementary scores go up, it is assumed that better prepared students will be entering middle school and then high school, and those scores will eventually increase greatly as well. This will be a question for future research. The second reason that growth in this particular study was lower at the secondary levels involves inconsistent implementation of the curriculum guides at the secondary levels. In a few of the secondary schools, guides were not followed as written, due to local school autonomy. The district plans to have more central intervention this coming year so that classroom instruction will more closely match assessments, and this will help discern whether it was implementation fidelity or some other factor that limited growth in grades 8-10.

### *Benchmarks*

Curriculum guides are necessary but not sufficient to improve student achievement. They provide a map of how to achieve the standards but not an evaluation of where students are with respect to this goal at any given time. It is for this reason that we believe well-written benchmark exams to be a crucial element required for the successful implementation of curriculum guides. To be effective and user-friendly, these benchmark exams must be aligned to the guides as well as to the standards test. Further, they should be reliable predictors of student

success on the statewide exam because they measure the same mastery of content that is the criteria for the state test.

Benchmark assessments take time to develop and implement. If they are to be useful, results from the exam must be given to teachers in a timely fashion. In this study, there was greater growth of performance during the 2004 - 2005 school year, a year in which benchmark assessments had been implemented and perfected, and the teachers had a full prior year of using the curriculum guides. When the benchmark results were delayed in reaching the teachers in 2003 - 2004, there were not significant gains in student achievement. Teachers were not aware of their students' progress or lack of progress in meeting the standards so they were not able to adjust their instruction as a result.

Administrative support for implementation of the guides, the analysis of benchmark results and professional development is crucial to improved student achievement (O'Shea, 2005). Schools who showed greater growth in student achievement were those who used staff development (Early Release) Mondays to analyze and discuss the results of the benchmark exams. At these schools, the benchmarks not only served as a method to ensure pacing was followed, but also as invaluable feedback as to what their students were learning and how instruction would need to be modified. This finding is consistent with Elmore (2002), that teachers from low-performing districts must be taught how to use data to improve instruction. Collegial discussions should include decisions about how to deal with material not learned. Patterns of student responses can be analyzed to inform instruction. Results from the high-stakes state tests arrive too late to help students with standards that were tested. Benchmark tests administered quarterly, on the other hand, give timely evidence whether the district's adopted

curriculum is being implemented so that adjustments may be made long before the state standards test is administered.

With the “No Child Left Behind” mandate for large-scale assessment has come a national debate about “teaching to the test” (Popham, 2004; Posner, 2004; O’Shea, 2005). Popham (2004) advocated that teachers should work to promote student learning of curricular aims represented by a test, not mastery of particular test items. If the students show mastery of the curricular aims of a test without benefit of prior knowledge of test items, then districts can with confidence draw conclusions about what students know. O’Shea (2005) iterated that, if state assessments are standards-based, then classroom instruction that focuses on the content and skills of the standards will improve student learning and increase achievement on statewide assessments.

Shepard (2004) proposed that

the single most important shared characteristic of large-scale and classroom assessments should be their *alignment with curriculum standards*. Not the limited alignment where test publishers show fit within test blueprints, but the more complete and substantive alignment that occurs when the tasks, problems, and projects in which students are engaged represent the range and depth of what we say we want students to understand and be able to do.

Greater student growth was seen in the 2004 - 2005 school year due not only to the teachers gaining experience in the use of the guides but also from their having a better understanding of what the standards mean. Having seen the benchmark exams the first year led to the teachers “teaching to the test”, meaning that they aligned their instruction to the curricular aim of the standards-based test. The California mathematics standards can be somewhat

ambiguous in terms of the depth of understanding or the range of contexts a student should know; therefore, the benchmark exams serve as a clearer translation for teachers of exactly what conceptual understanding is expected in each standard.

To serve as reliable feedback for teachers, the benchmark exams and the CST tests should be related, as they are both meant to assess the same body of knowledge, namely the content standards. Even though the development of the benchmark exams must make every effort to be independent of the CST tests so that the tests have different items and are an independent validation of content mastery and not just practice for the CST, both CST and benchmark assessments are designed to measure knowledge of the content standards for mathematics and correlation should be expected. Indeed, student performance on the quarterly assessments was correlated to CST results: when the district compared the results of 135 teachers of students achieving Proficient and Advanced on the quarterly exams with their results on the 2005 CST, the benchmark exams emerged as 90% accurate predictors of student CST performance.

### *Professional Development*

Professional development was offered as a component of the intervention because curriculum guides and benchmark assessments are necessary but not sufficient for improved student achievement. The better a teacher understands the standards, the more likely it is that his/her students will achieve proficiency. The better a teacher is informed about the best practices for using content guides and benchmark assessments, the better the gains should be.

As is evidenced both by the literature and the results, teachers who are involved in ongoing, on-site professional development that focuses on what students should know and be able to do are able to be more successful in teaching their students (Loucks-Horsley, Hewson,

Love, & Stiles, 1998; Haycock, 1998; Desimone, Porter, Garet, Yoon, Birman, 2002; Guskey, 1986). Of the 10 teacher leaders who consistently attended professional development (1 week in the summer and at least 40 hours throughout the academic year), the students of 8 teachers achieved the levels of Proficient or Advanced at a much higher rate than their peers. As for the two teachers whose students underperformed their peers, classroom observation of these teachers revealed poor implementation of ideas and activities learned through professional development and outline in the guides. These two teachers represent those who will continue to need professional development to increase their content knowledge as well as their understanding of how students learn math.

To be useful to the teachers, professional development must be focused on the conceptual understanding of the standards and must include active learning opportunities. Furthermore, it must introduce teachers to specific instructional practices that incorporate research-based pedagogy known to be effective with low-performing students. Ideas learned through professional development must be incorporated into the curriculum guides so that teachers know when to effectively use strategies learned. The 8 teachers whose students' demonstrated great success were adept at implementing ideas learned through professional development, as witnessed by observation in their classrooms. Further, the success experienced by teachers attending consistent professional development was based upon their receiving regular feedback on student learning progress through the benchmarks assessments so that they had direct evidence of the results of their efforts and the continual support and follow-up after the initial professional development. Those administrators who decided to discuss the results of the benchmark assessments as a staff provided a form of coaching for their teachers, which Guskey (1986) also suggested.

One problem for successful implementation of professional development in a low performing district within a mobile community such as Southern California is the turnover in teacher workforce. For the urban school district studied in this report, the turnover was great, particularly in the secondary schools. While there was a cohort of secondary school math teachers who attended focused, on-going professional development over the last two years, many of these teachers have since left the district. High teacher turn-over among teachers at the secondary level is an issue that the school district administration is beginning to address.

### Implications

This study points out the utility of a three-pronged approach whereby districts may be able to improve their students' math achievement: standards-based curriculum guides with pacing timelines and specific student outcome objectives; standards-based benchmark assessments, correlated to statewide assessments, from which teachers receive timely, concrete, specific feedback about student progress toward learning; and ongoing standards-based professional development that is focused on specific instructional practices in an active learning setting.

As the knowledge of the standards and assessment increases, so may the possibility of refinement, innovation and improvement in pedagogy. Teachers need to be offered multiple methods of teaching a standard that addresses the learning needs of their students: exploration with direct instruction (Tweed, 2004). Teachers can learn to use multiple resources to successfully teach standards in low-performing districts because using a variety of teaching strategies helps a wide variety of students learn.

However, just knowing what to teach is not sufficient. Teachers must also have clear goals for what is to be taught and know how to judge the degree to which progress is being made

towards those goals. Therefore, teachers of low-performing students need standards-based assessment questions to clearly understand what standards mean and what level of conceptual understanding a student should attain.

In being realistic about the implementation of change, one must address the concern that teachers may be resistant to being told what to do; i.e., be given a pacing guide. However, as Guskey (1986) points out, activities that are successful tend to be repeated while those that are perceived as not being successful or for which there is no evidence of success are avoided. Therefore, when teachers are able to observe that their students are becoming more successful in the benchmark assessments, they are more likely to return to professional development and to implement the innovations that are presented there.

When the students who have achieved the math standards at the Proficient or Advanced levels arrive at the secondary schools (grades 6 -12), they will need qualified teachers so quality professional development will have increased importance at the secondary level in order that these students will continue to retain their conceptual understanding and will not regress in their knowledge of math.

Work between teacher, district administration and an institute of higher learning is one hallmark of this study. The curriculum guides, benchmark assessments, and professional development were the result of a strong collaboration between the University of California, Irvine and the school district. Teachers worked with the Irvine Math Project leadership to generate the guides and the assessments. In addition, many teachers were involved in the revisions of the guides as well as in encouraging colleagues to attend professional development. The district bought the software to analyze the results. The research and evaluation department processed the assessments and distributed the results in a timely way during the 2004 - 2005

school year. The district was very involved in determining the professional development their teachers received. The district administration supported this effort by providing staff development days (1 Monday a month during 2004 - 2005). The district administration decided which content areas would receive professional development and the Irvine Math Project leadership facilitated these sessions. The district also supported the leadership training of a large number of teachers (2 for each elementary school -- one for K - 2 and one for 3 - 5--as well as 2 for every secondary school -- one for math and one for science). Some of these have decided to deepen their involvement in professional development by becoming Professional Development Providers (PDPs). These teachers will work alongside the Irvine Math Project to continue to provide instructional support for their colleagues during the academic year.

Now that this effort has seen the beginning of significant improvement in student achievement in math at the elementary level, the anticipation is that the district will continue its commitment to this work by further supporting its cadre of PDPs and by helping the University of California, Irvine and teachers to extend their efforts into science.

#### *Further Study*

Questions for further study might involve student achievement in future years. As more teachers attend professional development during the academic year, will there continue to be gains in students moving to Proficient or Advanced in next year's CST? Is there an upper limit to the growth? Will there be a decline in quality as the PDPs become the major providers of professional development? Will the growth seen in elementary grades be followed by a consistent pattern of growth in secondary schools during the next five years? Will this study replicate in other struggling districts? Can it be extended to other content areas? These and other questions will drive research and the refinement of this project. We are in place to introduce an

analogous system of science curriculum guides, benchmark assessments and professional development in 2005-2006. We are also in place to extend the mathematics guides-benchmark-professional development system that was reported in this paper to another district in Southern California.

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2005 AYP Criteria										
ENGLISH LANGUAGE ARTS						MATHEMATICS				
Elementary/Middle	24.4%					26.5%				
High Schools	22.3%					20.9%				
ENGLISH LANGUAGE ARTS						MATHEMATICS				
Proficient or Above						Proficient or Above				
Schools	2002	2003	2004	*2005	+/-	2002	2003	2004	*2005	+/-
MA	8.5	10.5	10.9	13.2	2.3	5.5	8.2	7.9	13.5	5.6
MB	5.9	11.4	10.6	14.8	4.2	7.8	10.7	9.7	14.2	4.5
MC	10.4	10.4	12.0	15.8	3.8	6.4	8.1	3.4	11.6	8.2
MD	6.6	17.0	18.5	20.4	2.0	3.8	14.2	17.4	18.4	1.0
ME	21.3	17.9	19.2	20.0	0.8	21.0	13.8	15.6	17.9	2.3
MF	9.3	9.6	13.9	16.2	2.3	4.4	15.3	8.0	17.6	9.6
MG	10.2	8.7	7.9	9.6	1.7	9.3	9.0	7.2	7.9	0.7
MH	6.3	5.9	10.4	9.3	-1.1	5.8	12.2	29.0	21.0	-8.0
ENGLISH LANGUAGE ARTS						MATHEMATICS				
Proficient or Above						Proficient or Above				
Schools	2002	2003	2004	*2005	+/-	2002	2003	2004	*2005	+/-
HA	7.4	7.6	10.5	12.4	-1.9	1.7	0.07	12.5	6.7	-5.8
HB	7.9	16.4	19.1	26.5	7.4	4.0	9.1	11.9	19.1	7.2
HC	5.6	13.0	11.2	26.9	15.7	3.9	12.0	18.8	22.9	4.1