Urban Elementary Schools in California Show Stunning Improvement in SAT-9 Test Scores over Initial Four Year Period of New Math Standards

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June 19, 2004

Summary: The state of California adopted new math standards in 1997, featuring a more focused mathematics curriculum, coherent from one year to the next, with a primary goal of having students fully ready for success in California Algebra I by the end of the seventh grade. The “Key Standards” approach was implemented in 2000, greatly reducing the number of topics and allowing students to focus on the core curriculum, including a strong pre-algebra component.

A set of schools from low income and/or minority districts aggressively adopted and started to implement these new California methods for the 1998-1999 school year. Most of the “early adoption” group of elementary schools purchased and began using matching textbooks when they first became available for the 1999-2000 school year, and all were using them by the following year. During the same period, including the last year of the Mathland era and the first 4 years of the new curriculum, SAT-9 tests were administered to virtually all grade 2-11 students in the state, providing a unique opportunity to measure grade 2-6 cohort performance improvement from a documented baseline, primarily Mathland, both within the state and against national norms.

Improvements in test scores for the small number of schools and districts which aggressively implemented the new math standards have been stunning. Four early-adoption urban school districts comprising over 67,000 students far exceeded the improvement performance of the state average during this period, even though their percentage of economically disadvantaged students (EDS) greatly exceeded the state average (Figure 1). One such district raised their average SAT-9 score by 40 percentile points, starting from a Mathland low of 19. Three early-adoption pilot schools in the LA Unified School District showed similar superior improvement during the same period, achieving an average improvement of 30 percentile points. The champion pilot school raised their average score by 39 percentile points, even though they had 99% EDS, and 70% English learners.

The LAUSD as a whole, which chose to retain their old math program, showed an improvement of only 10 percentile points, roughly half the state average. This modest improvement may be attributed to the class-size reduction program implemented in all California schools during this same period, as well as to the reduction in primary instruction in Spanish. The San Diego City School District, which created their own Math Framework approach in 1998, based on a New York City model, performed even worse than the LAUSD, even though they have a significantly lower EDS percentage.

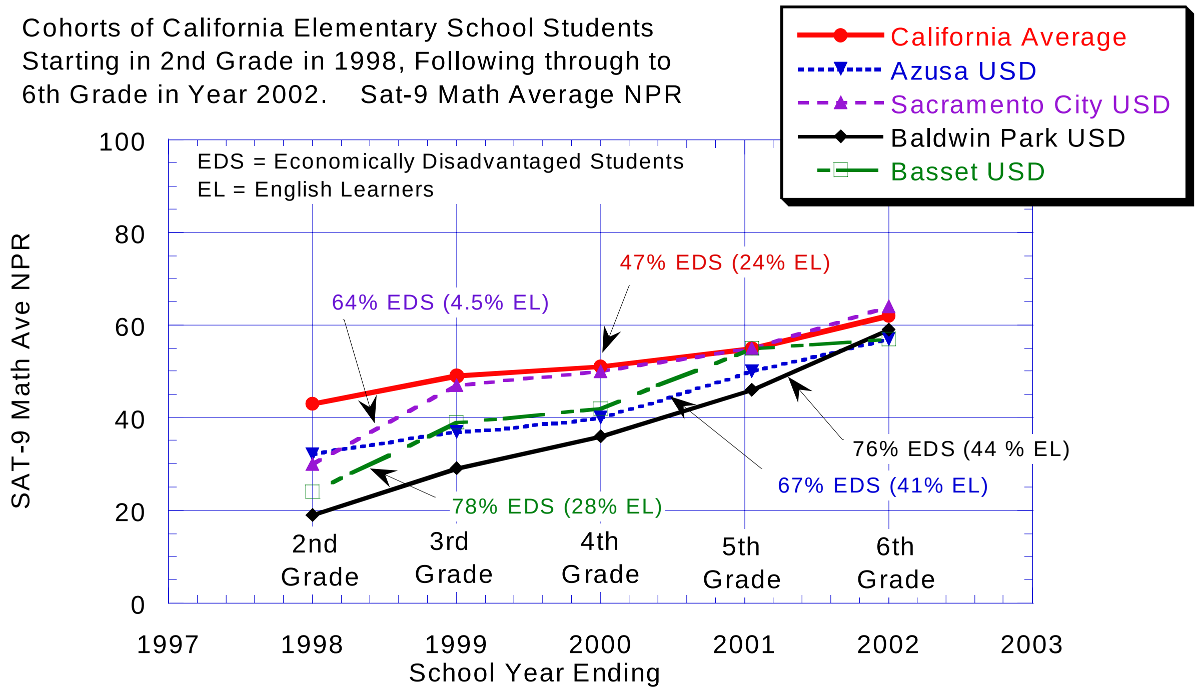

Figure 1 - Four Large Urban School Districts: Showing the stunning gains made by four large urban school districts relative to the California average. All these districts aggressively implemented and taught to the new California Math Standards starting in 1998, and purchased and used the California adopted Saxon Math Elementary School textbooks All came close to the California average by 2002 despite starting as much as 24 percentile points below the average. All these districts had far higher ratios of Economically Disadvantaged Students than the California average of 47 %, and two had far higher percentages of English Learners.

Introduction

The new California Mathematics Standards were approved in late 1997, and statewide SAT-9 testing with online school scores began that same academic year. This fortunate situation has produced some of the most powerful evidence available that the "constructivist" approach of the previous decades, culminating in the 1992 California Mathematics Framework and subsequent curricular approval of 1994, was a misguided failure. Other changes have been made that contribute to the progress as well. Primary instruction in Spanish with little attention to English has been dramatically reduced, although far from eliminated, since the passage of Proposition 227 in 1998. A much reduced class size in the early grades was implemented at roughly the same time.

Newspaper articles about sharply higher test scores in certain schools or districts began appearing in 2000 [1]. An investigation of these schools and districts revealed that all had chosen to aggressively adopt and implement the new math standards for the 1998-99 school year, even without having appropriate textbooks. The first matching textbook series (Saxon Math, SADLIER-OXFORD, and SRA) were approved for state use in June of 1999, and all these districts purchased and started using the Saxon books in the 1999-2000 school year, or in one case the following year.

This may be contrasted with the more common reaction of school districts around the state, which was to waffle, stall or actively oppose the new math curriculum and methods. The Los Angeles USD, for instance, made an overt effort to delay implementing the new curriculum, although they did allow a few pilot schools to aggressively adopt and implement the standards, and to purchase the Saxon textbooks. The San Diego City school district created and implemented their own standards at about the same time, based on ideas their Chancellor of Instruction brought from New York City's District #2.

With the notable exception of San Diego City among major urban areas, California is now steadily moving toward complete adoption of the new curriculum and methods. Language Arts (English) and Mathematics have been officially declared the two priority subjects in California, in line with the federal "No Child Left Behind (NCLB)" legislation. Title I departments at elementary schools are beginning to focus on early math intervention in the fashion that has been so successful in reading. A wider selection of approved textbooks are available. Various state universities and colleges are offering algebra review courses for elementary teachers. Local school districts are also organizing innovative algebra review sessions. In order to graduate from high school, a demonstration of basic algebra proficiency is scheduled to be required by every child in California. Schools which do not show improvement in Math and Language Arts may be taken over by the state, and teachers can lose their seniority. It appears the public is behind this math program, as are the state authorities and much of the academic community.

Quantitative demographic data has been compiled and is shown on the performance graphs in this paper, including data on the percentage of "Economically Disadvantaged Students" and the percentage of "English Learners". A small school district known to have delayed adoption has been included, as well as a large one which created it's own math standards. All the SAT-9 performance data and all the demographic data is available on the web at the STAR section of the California Department of Education web site [2]. Detailed summary data is available for each school, district, county and for the state at that site. The appendix of this paper contains all the data used to compile the graphs shown here, and also includes demographic data on four large counties in order to provide background information on the general public school population in California.

Summary of SAT-9 Test Results

Four Early-Adoption School Districts - Three urban school districts in Southern California and one in Northern California were found to be early adopters, all using the Saxon Math textbooks (Figure 1). This graph shows the improvement in the SAT-9 average NPR scores for a cohort of students who were 2nd graders in 1998, 3rd graders in 1999, and so on up to 6th graders in 2002. The data shows improvements in these districts ranged from 24 to 40 percentile points, with an average increase of 30.5 points. This may be contrasted with the California average improvement during the same period, which was not bad at 19 percentile points, but still well below these early-adoption districts.

Another remarkable feature of this graph is the proportion of Economically Disadvantaged Students (EDS) and English Learner students (EL) at these school districts. For the year 2002, the percent of such tested students in relation to all the students tested is shown on the graph for each of the four school districts. EDS students range from 64% to 78%, in contrast to the California average of 47 %. The school district with the best SAT-9 improvement (Baldwin Park at 40 points) also had the highest proportion of English learners at 44 %, in contrast to the California average of 24 % EL.

The total number of students tested in these four districts was 67,143 which was 97.7 % of the students enrolled, with approximately one-half in the elementary school grades. This is a statistically significant number of students with higher than average economic disadvantages and, in two cases, far more English Learners than the average. This five-year data trend would seem to show that the new California methods work very well for disadvantaged students and for English learners, and thus the phrase “stunning improvement” is not an exaggeration

Three Pilot Schools in the Los Angeles Unified School District: Several elementary schools were allowed to become early adopters for the new California Math standards starting with the 1998-1999 school year, and to purchase the state-approved Saxon Math textbooks (Figure 2), even though the school district itself made an overt effort to delay adopting the new curriculum. These elementary schools only go to grade 5, and so a blended cohort was created for Figure 2 in order to show 5 years worth of data. The start point for the curves is the 2nd grade 1998 SAT-9 Math average NPR data, and the end point is the 5th grade 2002 data. The data shown for 1999 is the mean of the 2nd and 3rd grade SAT-9 Math average NPR scores, and the data for 2000 and 2001 is calculated in a similar manner, as shown on the figure. Figure 2 shows a very modest 12 percentile points improvement for the LAUSD as a whole, somewhat below the state average of 15 points improvement for the same cohort. The performance of the three pilot schools relative to the entire LA district is shown in figure 3. The most sensational case is that of 9th Street Elementary, which started 15 percentile points below the LAUSD and finished 12 percentile points above the LAUSD, for a net gain of 27 percentile points. This for a school with 99% Economically Disadvantaged Students, and 70 % English learners. The other two schools also did well, each finishing 18 percentile points higher than the LAUSD. Annandale would probably have done even better, but the Saxon textbooks were removed for the 2001-2002 school year, and replaced with district mandated textbooks. Those schools had 90% and 72% Economically Disadvantaged Students, respectively, all three schools being far above the state average of 47%.

The total number of students tested in these three schools was 1,043, which was 97.8 %

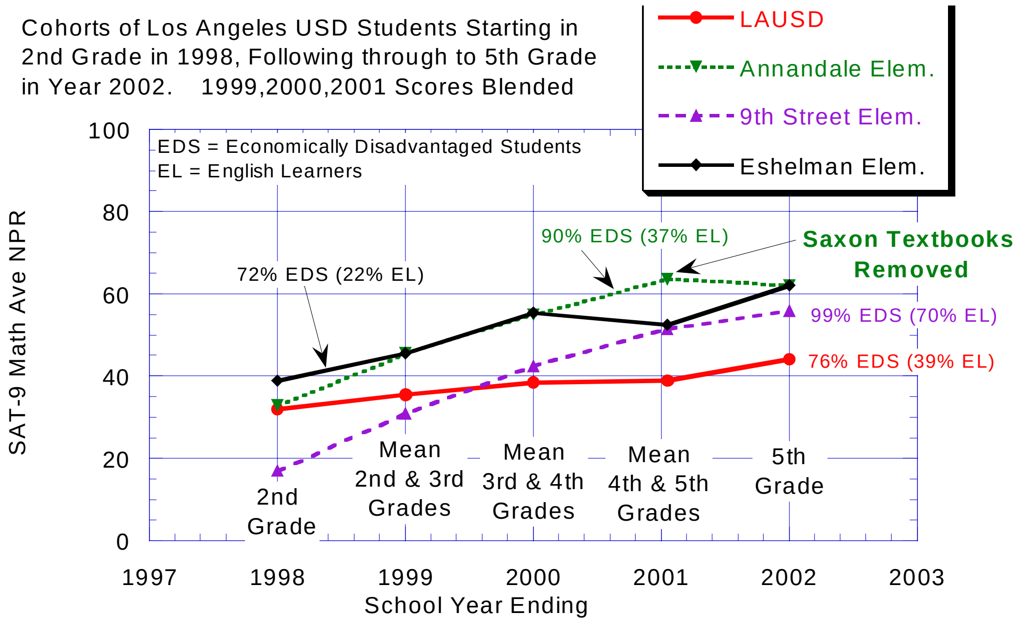

Figure 2 - Three Pilot Schools in the Los Angeles USD: Showing the stunning gains made by three Los Angeles USD inner city elementary schools relative to the LAUSD average. These three schools also aggressively implemented and taught to the new California Math Standards starting in 1998, and were allowed to use the Saxon Math textbooks as part of a pilot test program. 9th Street Elementary clearly had the best improvement record, raising it's score by 27 percentile points relative to the LAUSD average NPR. Notice that 9th Street Elementary has 99 % Economically Disadvantaged Students, and 70 % English Learners, both far above even the high LAUSD averages. All three elementary schools have far higher percentages of Economically Disadvantaged Students than the California average of 47 %.

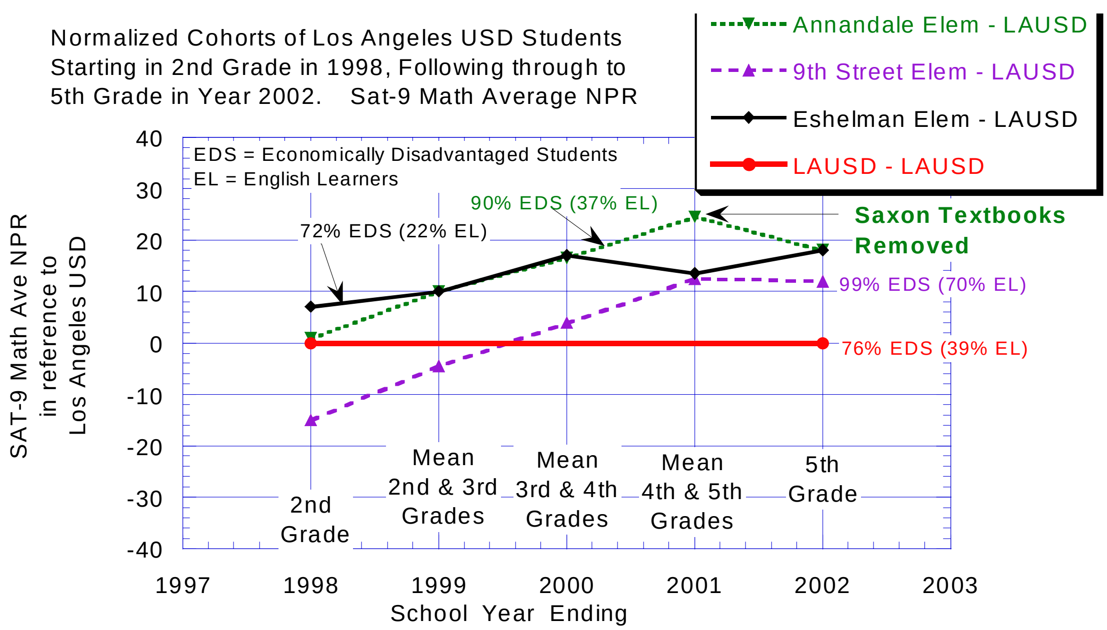

Figure 3 - Three Pilot Schools Normalized to the LAUSD Average Scores: This graph is the same as Figure 2, except the data from the LAUSD has been subtracted from that of the three pilot schools for each year.

of the enrolled students. The LAUSD was known to have made an overt decision to delay implementing the new curriculum. Thus the baseline for these results was better defined than the California average used in Figure 1, and the ratios given in Figure 3 are considered to be statistically significant. Considering the very high EDS percentages, these improvements can also be counted as a stunning result, and support the proposition that the California methods work well with disadvantaged students.

Two Suburban School Districts: Data was also obtained from a school district in LA County with a very low rate of disadvantaged students, and from a district in Ventura County with a rate about one-half that of the California average (Figure 4). The former district (Manhattan Beach) was an early adopter, aggressively implementing the new Standards and purchasing the Saxon textbooks for the 1999-2000 school year. This district started out with a 1998 baseline of 74 Math Average NPR, and in four years climbed to an astronomical 92 (see Appendix for 5th grade score in 2002).

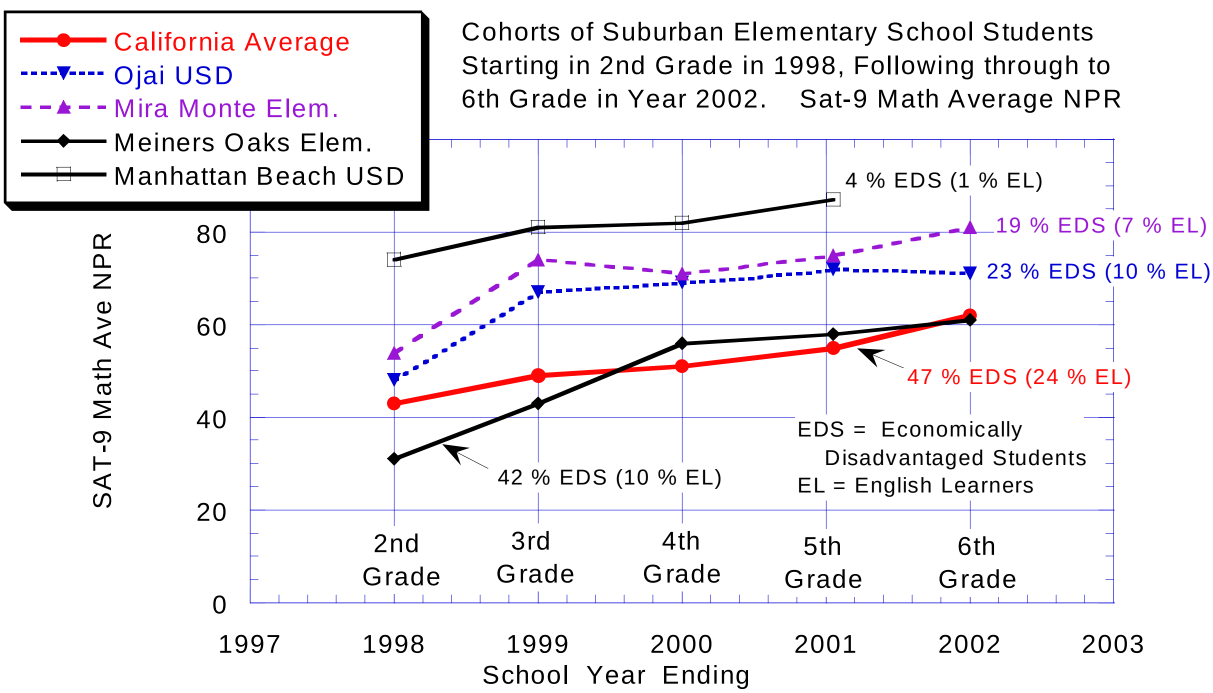

Figure 4 - Two Suburban School Districts: Showing gains made by two school districts with much lower percentages of Economically Disadvantaged Students than the California average of 47 %. The Manhattan Beach USD aggressively implemented and taught to the new California Math Standard in 1998, and bought the Saxon Math textbooks for their elementary schools. Their performance was remarkable. The Ojai USD did not aggressively implement the new 1998 California Math Standards. They did not buy California adopted books until 2002, and teachers remain dubious about algebra, one of the key features of the California methods. The Ojai USD and two of their elementary schools showed an initial jump in performance, but showed minimal improvement after that.. We speculate the failure to improve after that may have been due to the failure to embrace the strong pre-algebra component of the Key Standards .

The latter district (Ojai) chose to delay, and had no approved California textbooks until the 2002-2003 school year. Teachers still doubt 3rd, 4th and 5th graders can actually learn algebra. This district had an initial jump in SAT-9 scores, and then leveled off to an improvement rate less than that of the California State average. Data from the school with the highest proportion of economically disadvantaged students and English learners (Meiners Oaks) parallel that of a school with a much lower proportion of EDS (Mira Monte), suggesting demographic factors had little to do with these results.

The San Diego City School District: San Diego City chose to create and aggressively install (in 1998) a new math curriculum called the "Blueprint for Student Success in a Standards Based System". This curriculum and teaching approach was modeled after reforms in the New York City District #2. The main reference document is labeled "Institute for Learning, San Diego's K-12 Mathematics Framework" [3]. It asserts to be "convergent with" the California Framework Document, the National Council of Teachers of Math (NCTM) 2000 Standards and Principals, and several educational researcher's books.

This school district participated in the California SAT-9 tests from 1998 through 2002. The SAT-9 grade 2-6 cohort results are shown in Figure 5 as compared to the California average, and in Figure 6 as compared to the similar large urban school districts that aggressively adopted the California Standards and methods. The improvement of the San Diego cohort was only 8 percentile points, as compared to an improvement of 19 for

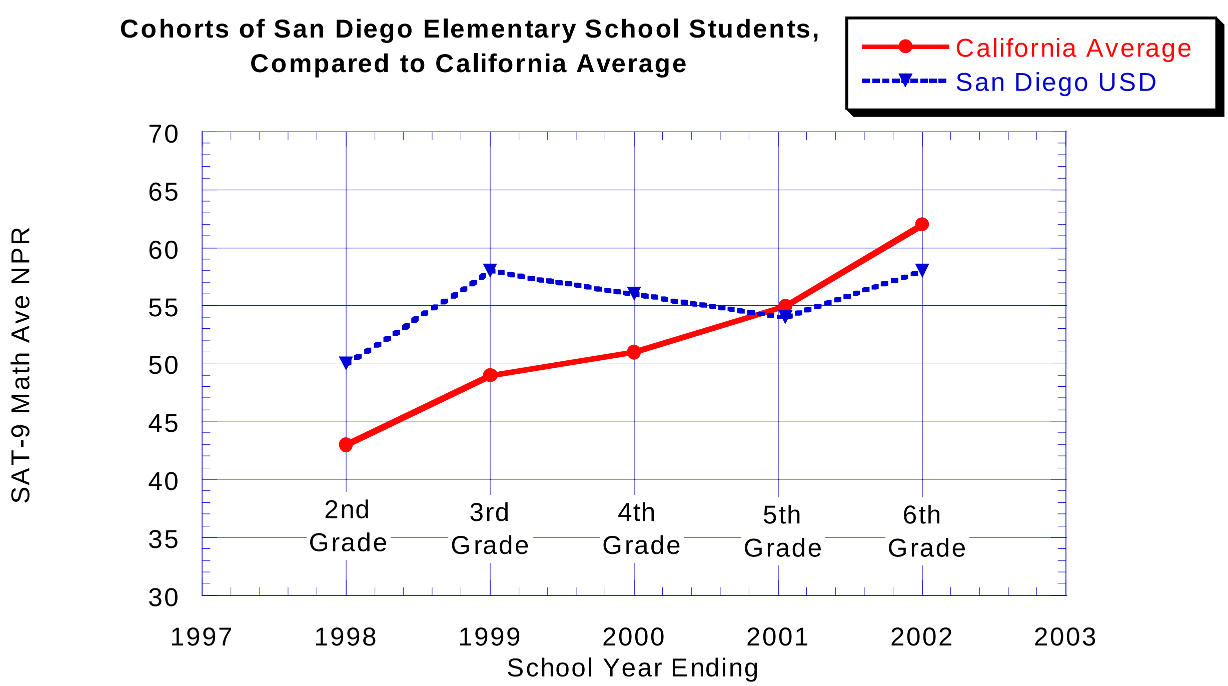

Figure 5 - San Diego City School District Elementary Schools Compared to the California State Averages.

the state average and improvements of up to 40 percentile points for the early adopters, even though the early adopters had a higher percentage of economically disadvantaged students. The San Diego "go it alone" approach appears to be a misguided failure based on the 5 year national SAT-9 test results.

When early math results were disappointing, San Diego hired the American Institutes for Research to evaluate their program. The Year 2 Interim Report was just published [4]. Although this report appears to make no judgement on the curriculum, it does agree with the performance conclusions given in this paper. It reiterates some of the original goals of the San Diego program, including the use of high quality materials, and massive investments in professional development, and further notes the continued teacher dissatisfaction.

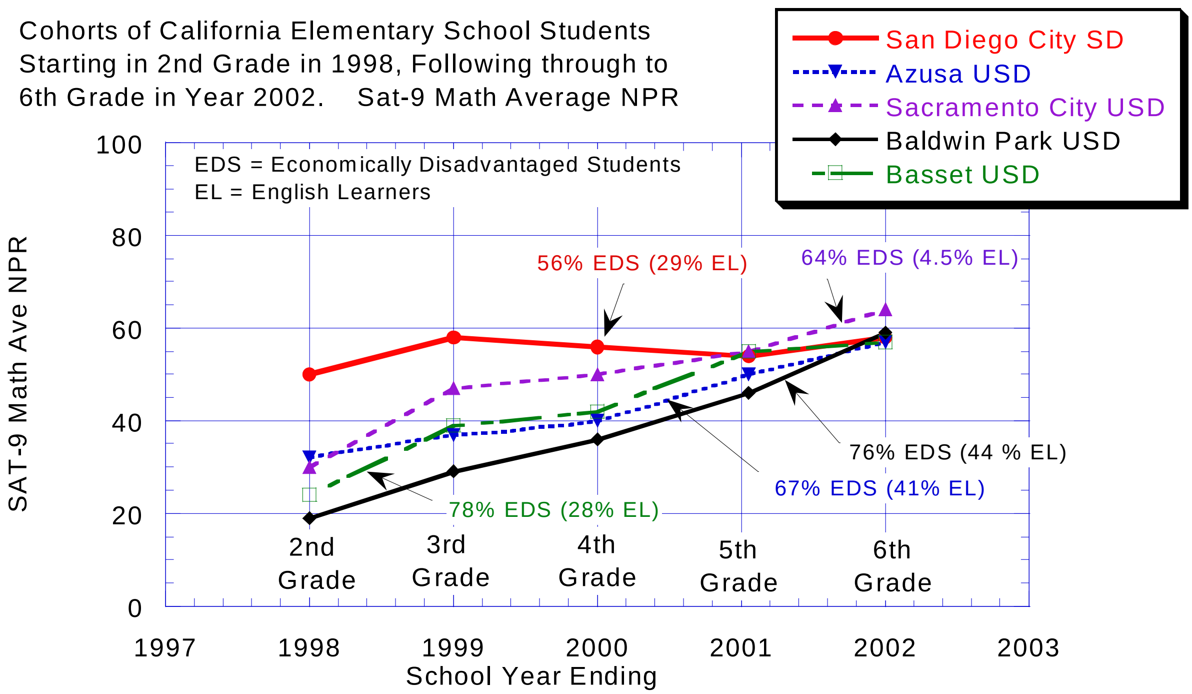

Figure 6 - San Diego City School District Elementary Schools Compared to Four Early-Adoption Urban Elementary School Districts: The total number of tested students in the early-adoption districts was 67,143, comparable to the SDC district. The average ratio of economically disadvantaged students was 68 % for these early-adoption districts, well above the San Diego ratio of 56 %.

Discussion and Conclusions

The reaction of individual elementary teachers to the 1997 California Standards appears to be mixed. In at least one school district (Ojai USD), teachers still doubt that 3^{rd}, 4^{th} and 5^{th} graders can learn algebra. On the other hand, teachers at one of the high-performing districts described in this paper (Azusa), reported they thought they had "died and gone to heaven" when they reported for work in the fall of 1999 and found the Saxon books in their classrooms instead of the hated MathLand books. In regard elementary teacher's skill at algebra, there is anecdotal evidence that basic algebra of the sort required to tutor grades 1-6 California math can be quickly re-learned by algebra-phobic parents and grandparents even 50 years after their last exposure to algebra. One would think that teachers could do at least as well.

The California/Singapore approach has been criticized as being elitist, catering mainly to the college bound student. Proponents of the California approach have taken the opposite position, that a solid grounding in pre-algebra by the 7^{th} grade with traditional Algebra I in the 8^{th} grade is the key to success in high school and for most decent jobs in this modern era, and it is the average student without access to tutoring or a college-educated parent who is being cheated by the existing NCTM-based curriculums. Urban sixth grade students in the early-adopting schools and districts in the year 2002 are obviously much better prepared for the math-intensive 7^{th} and 8^{th} grade, and for high school, than were their 1998 older siblings. That the California curriculum also greatly helps the student with well-off or sophisticated parents, as was shown with Manhattan Beach, demonstrates that this approach is not at the expense of the traditionally high-performing students.

The most comprehensive analysis of conclusions which can be drawn from the 1995 TIMSS math test results was published by the director and by researchers at the U.S. National Research Center for TIMSS at Michigan State University, in the American Educator, Summer 2002 [5]. The authors carefully characterized the grade 1-8 curriculum for the top 6 performing (A+) countries, and compared that curriculum, on the same basis, with the curriculum from the 21 U.S. states which participated (California did not participate). In comparison with the A+ countries, the U.S. curriculum was found to contain far too many topics (22 topics in the 1^{st} grade and 23 in the 2^{nd} for the U.S, versus 5 topics in the 1^{st} and 9 in the 2^{nd} for the A+ countries). It was also too repetitive, not very demanding in the middle grades, and incoherent. By incoherent, they mean that topics do not build on previous topics in a logical way. The authors use the word "focused" to describe the reduced number of topics, and say "Math is a handful of basic ideas; but in the U.S. mathematics standards are a long list of seemingly unrelated, separate topics."

Only in California have these TIMSS conclusions been put into practice. The list of Key Standards reduces the number of topics to a quantity roughly the same as that of the A+ countries (three topics in the 1^{st} grade, nine in the 2^{nd} grade, ten in the 3^{rd}, etc.) In regard to coherence, an examination of the Algebra and Functions strand, for instance, shows the careful and logical build-up of algebraic reasoning starting in the 3^{rd} grade, with no topic nor problem introduced until the child has the tools to handle it. With the more focused, coherent sequence of topics, teachers can spend much more time on the important ones, and all teachers and parents will know exactly what will be covered by the state tests.

The TIMSS authors conclude that their findings are even more important for the average student than for the college bound one. The results shown in this paper seem to support that conclusion, and are extremely important considering the soon-to-be enforced California state requirement that every child must demonstrate proficiency in algebra in order to graduate from high school

The results in this paper also appear to show the folly of delaying the aggressive adoption of the California curriculum within the state, or of trying to invent an alternate to that of the A+ countries.

The state switched to a more California focused testing system for the school year ending in 2003, which is good for everyone except researchers. Nevertheless, the 5 year period of SAT-9 testing has provided overwhelming evidence of how to improve student mathematics conceptual understanding and performance in the critical elementary school years.

References

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Appendix

2002 Demographic Data, Derived from California STAR 2002 Report

Entity	All Students			Economically Disadvantaged		English Learners	
	Enrolled	Tested	Ratio	Tested	Ratio	Tested	Ratio
California Average	4,765K	4,616K	97 %	2,186K	47 %	1,115k	24 %
Azusa USD	9,540	9,402	99 %	6,295	67 %	3,815	41 %
Sacramento City USD	40,817	39,628	97 %	25,434	64 %	1,768	4.5 %
Baldwin Park USD	13,752	13,598	99 %	10,331	76 %	6,016	44 %
Basset USD	4,602	4,515	98 %	3,525	78 %	1,254	28 %
Los Angeles USD	567K	540K	95 %	412K	76 %	212K	39 %
Annandale Elem.	263	259	98 %	232	90 %	97	37 %
9th Streetd Elem.	318	309	97 %	307	99 %	216	70 %
Eshelman Ave. Elem.	485	475	98 %	342	72 %	105	22 %
Ojai USD	3,140	2,969	95 %	683	23 %	286	10 %
Mira Monte Elem.	389	378	97 %	73	19 %	25	7 %
Meiners Oaks Elem	424	410	97 %	171	42 %	43	10 %
Manhattan Beach USD	4,881	4,790	98 %	189	4 %	35	1 %
San Diego City SD	103,616	100,847	97 %	56,251	55.8 %	28,728	28.5 %
LA County	1,329K	1,287K	97 %	795K	62 %	408K	32 %
Orange County	386K	377K	98 %	142K	38 %	112K	30 %
Santa Clara County	189K	185K	98 %	50K	27 %	43K	23 %
Santa Barbara County	51K	50K	98 %	22K	44 %	14K	28 %

California SAT-9 Test Results, 1998 through 2002, From California STAR Reports

California SAT-9 Math Ave NPR

Grade	1998	1999	2000	2001	2002
2	43	50	57	59	63
3	42	49	57	61	64`
4	39	44	51	54	58
5	41	45	51	55	58
6	48	52	57	60	62

Azusa USD SAT-9 Math Ave NPR

Grade	1998	1999	2000	2001	2002
2	32	46	46	51	52
3	28	37	49	52	53
4	26	32	40	49	51
5	29	34	46	50	54
6	30	37	42	48	57

Sacramento City USD SAT-9 Math Ave NPR

Grade	1998	1999	2000	2001	2002
2	30	46	55	57	57
3	30	47	56	60	59
4	32	39	50	57	58
5	34	43	49	55	58
6	43	53	61	64	64

Baldwin Park USD SAT-9 Math Ave NPR

Grade	1998	1999	2000	2001	2002
2	19	30	43	48	57
3	22	29	49	53	59
4	23	24	36	45	50
5	25	29	34	46	51
6	38	42	48	52	59

Bassett USD SAT-9 Math Ave NPR

Grade	1998	1999	2000	2001	2002
2	24	43	42	54	55
3	27	39	48	54	57
4	25	32	42	51	55
5	25	34	35	55	53
6	31	40	45	47	57

Los Angeles USD SAT-9 Math Ave NPR

Grade	1998	1999	2000	2001	2002
2	32	36	41	44	53
3	30	35	42	49	54
4	27	30	35	39	47
5	28	31	35	39	44
6	30	34	37	39	42

Annandale El. SAT-9 Math Ave NPR

Grade	1998	1999	2000	2001	2002
2	33	49	50	57	62
3	28	42	62	71	63
4	22	27	48	65	57
5	23	28	47	62	62

Ninth St El SAT-9 Math Ave NPR

Grade	1998	1999	2000	2001	2002
2	17	35	29	34	47
3	50*	27	39	52	54
4	30	30	46	60	66
5	21	35	43	43	56

Eshelman Ave El SAT-9 Math Ave NPR

Grade	1998	1999	2000	2001	2002
2	39	39	48	57	71
3	48	52	61	66	74
4	27	52	50	61	67
5	41	25	48	44	62

Ojai USD SAT-9 Math Ave NPR

Grade	1998	1999	2000	2001	2002
2	48	58	67	69	67
3	49	67	52	75	73
4	51	52	69	70	65
5	48	58	64	72	72
6	62	65	70	71	71

Mira Monte El. SAT-9 Math Ave NPR

Grade	1998	1999	2000	2001	2002
2	54	57	60	75	80
3	62	74	75	76	80
4	33	52	71	73	64
5	45	46	70	75	79
6	66	60	59	76	81

Meiners Oaks El. SAT-9 Math Ave NPR

Grade	1998	1999	2000	2001	2002
2	31	58	66	59	64
3	28	43	63	61	53
4	49	53	56	65	55
5	37	65	52	58	66
6	54	60	65	55	61

Manhattan Beach USD SAT-9 Math Ave NPR

Grade	1998	1999	2000	2001	2002
2	74	82	89	93	92
3	79	81	87	92	93
4	81	82	82	87	92
5	83	85	88	87	92

San Diego USD SAT-9 Math Ave NPR

Grade	1998	1999	2000	2001	2002
2	50	57	65	61	63
3	47	58	64	61	65
4	43	47	56	52	55
5	46	47	51	54	55
6	49	52	55	55	58