Fullerton School District
Fullerton, California
Program Evaluation

Laptops for Learning
Year Two: 2005-2006

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Executive Summary

This report details the results of an evaluation of the second year of the Laptops for Learning program in Fullerton School District, located in Orange County, California. The Laptops for Learning program is a one-to-one initiative in which approximately 2000 students and 85 teachers in four of Fullerton School District's 20 schools use laptops as an integral part of the teaching and learning experience. Data collected and analyzed during the second complete year of the Laptops for Learning program indicate:

- The most predominant use of the laptops by students was for the writing process as reported by both teachers and students.
- Other uses of the laptops by students include presentations, Internet research and Comic Life application.
- At home students demonstrated 21st century skills by using the laptop to complete homework, listen to music, and surf the Internet.
- Students used the laptops in all content areas, however Language Arts, Social Studies, and Science are the most commonly assigned content areas.
- Teachers planned technology based lessons, implemented district provided software and the Internet in lessons, and used the laptops to communicate with colleagues and assess students.
- Teachers became more proficient at using their laptops, which will ultimately result in a trend to use the laptops for authentic teaching and learning on a regular basis.
- Students had positive opinions of the laptop program however concerns about the weight of the laptops and technical difficulties were also expressed.

- Students felt privileged and proud to be involved in the Laptops for Learning program.
- As a group, teachers had positive opinions of the Laptops for Learning program.
- Teachers reported that the program has positively impacted all learning groups (Gifted, Special Needs, ELL, and no special needs).
- Teachers had concerns about technical difficulties and using the laptops to meet state content standards.
- Parents had similarly positive opinions of the Laptops for Learning program.
- Parents reported that the program has improved student study habits, however there are genuine concerns about the use of laptops at home for play and Internet surfing.
- As a group, parents and teachers recommend the program be continued.
- CST ELA and math scores provided no direct evidence of enhanced learning through the Laptops for Learning program.
- Benefits of the program included a 21st century learning environment, meeting the needs of all learners, and preparing students for technology rich careers and academics
- Challenges the Fullerton School District faced stem from the cost of the laptops, technical difficulties, cross-platform issues, and inappropriate use of the laptops.
- Recommendations for Fullerton School District include continuing to work on negotiating the cost of the laptops and educating parents as to the use of laptops in school, how to help their children with electronic homework, and at-home laptop discipline.

Introduction

The Laptops for Learning program in Fullerton School District is a one-to-one computing initiative that was launched for the 2004-2005 school year in three district schools (Nicolas Junior High School, Robert C. Fisler K-8 School, and Hermosa Drive Elementary School). More than 1,000 students from grades 2-7 were provided Apple iBook computers as part of this pilot one-to-one computing initiative. At the commencement of the 2005- 2006 academic year, the Laptops for Learning program was extended to include approximately 2,000 students and 85 teachers from four schools (Nicolas Junior High School, Robert C. Fisler K-8 School, Hermosa Drive Elementary School, and Golden Hill Elementary School).

Participants in the program included: all 7th and 8th grade students and teachers at Nicolas Junior High School; all 2nd through 8th grade students and teachers and nine (9) first grade students in a 1-2 combination class at Robert C. Fisler K-8 School; two classes of gifted and talented students, a 5th and 6th grade combination class, and all 6th grade students and teachers at Hermosa Drive Elementary School; and all 6th grade students at Golden Hill Elementary School. This report presents evidence of the use of and opinions of laptops for teaching and learning in these four Fullerton School District schools. Specifically, this report presents evidence of how teachers and students used the laptops for the 2005-2006 school year, as well as insight into the attitudes and beliefs of those involved with this one-to-one computing initiative.

This report draws from survey data as well as district supplied school records.

Background

The Laptops for Learning initiative of Fullerton School District was in its second year during the 2005-2006 academic year. In 2004, students and teachers at three district schools received Apple iBook computers. In addition to laptop computers, schools were prepared for digital teaching and learning in that classrooms and schools were equipped with wireless Internet access, associated hardware (including but not limited to projectors, printers, and scanners), and educational software and online teaching and learning resources. Additionally, a well-planned professional development program was implemented to prepare teachers for 21st century teaching. It should also be noted that one school, Robert C. Fisler K-8 School was opened for the 2004-2005 school year as a school with a focus on science and technology and equipping the school as a 'high tech' school was part of the design process. For the 2005-2006 school year the Laptops for Learning program expanded to include one more school site that was prepared for digital teaching and learning in the same way the pilot schools were. Training of teachers by school district personnel as well as external trainers representing Apple Computing Inc. occurs on a continual basis. Technical support is offered by Fullerton School District.

Evaluation Design

This report describes the second year evaluation of the Fullerton School District Laptops for Learning program. More specifically, the questions guiding the evaluation were:

1. How are the laptops being used for teaching and learning in the Fullerton School District?
2. What are student, teacher, and parental opinions of the Laptops for Learning program in Fullerton School District?
3. How has one-to-one computing access in Fullerton School District impacted student attendance, discipline, and test scores?
4. What are the benefits and challenges of continued implementation of a one-to-one laptop initiative in Fullerton School District?

The evaluation team used survey methodology and statistical analysis of school data. Specifically, the evaluation team collected data through parent, student, and teacher surveys for guiding questions 1, 2, and 4, and accessed school records and accountability reports for guiding question 3. Surveys were administered to parents, teachers, and students. Teacher and student surveys were administered electronically using Zoomerang (http://www.zoomerang.com).

Student surveys

Student surveys were created in two formats, one for students in 1st and 2nd grade and another for students in 3rd through 8th grade. First and Second grade surveys consisted of 26 questions (20 multiple choice and 6 open-ended). Questions asked students about the use of the laptops for the different content areas while at home and at school, personal

use at home, and the student opinion of their participation in the Laptops for Learning program. Multiple choice questions gave students options of answering *yes, no,* or *sometimes / I don't know* to questions about their opinion of the laptop program (e.g., Do you think having a laptop makes school more interesting?). Other questions asked students to report on use of laptops in the content areas as *daily, weekly, monthly, a few times a year,* or *not at all*. Open-ended questions asked the student about their comfort level with technology and their favorite and least liked thing about being a participant in the Laptops for Learning program.

Third through eighth grade student surveys consisted of 15 multiple choice type questions and four open-ended questions. The multiple choice type questions were more specific than in the 1st through 2nd grade student survey in that they asked students to *agree,* be *neutral,* or *disagree* to questions about the impact of the laptop on their learning and learning preferences (e.g., I am more involved in school when I use my laptop). Multiple choice questions also asked students about their current proficiency level and use of specific programs such as My Access!, United Streaming, and Keynote. Open-ended questions asked students to share their favorite and least liked part about being a participant in the Laptops for Learning program

Teacher surveys

Teacher surveys were between 30 and 38 questions depending on if teachers implemented My Access! into their teaching. Teachers who implemented this application into their teaching had an additional 8 multiple choice questions specific to My Access! Multiple choice questions enquired as to teaching experience, technology proficiency, home use of computers, use of computers for preparing teaching, assessing students, and

assigning student work. Most multiple choice questions asked teachers to *agree,* be *neutral,* or *disagree* or to report frequency of use by *daily, weekly, monthly, yearly,* or *not at all.*

Parent surveys

Parent surveys were distributed in English, Korean, and Spanish and consisted of 27 multiple choice questions and one open-ended question that asked parents if they had any comments about the laptop program. Multiple choice questions asked about home computer and Internet access and use, student use of laptops at home, and parent opinion about student learning using laptops.

School accountability reports

Data for reporting the potential impact of the Laptops for Learning program on student discipline was collected from the School Accountability Report Cards for 2006, which will soon be available at the Fullerton School District website.

California Standards Test (CST) scores

Student scores on the California Standards Test were downloaded from the website of the vendor which the district uses for data storage and reporting.

Evaluation Data

After receiving institutional research protocol approval, student, teacher, and parent surveys were administered at three of the schools at the end of the second year of the Laptops for Learning program. In the case of Robert C. Fisler School, student surveys were completed at the beginning of the third year of the program, and student surveys were reworded to ask students to reflect on their experiences in the Laptops for Learning program during the 2005-2006 school year.

Student and teacher surveys were administered using Zoomerang (http://www.zoomerang.com), an online survey tool available through the lead evaluator's institution. Teachers and students were provided the URL by district personnel (originally from the superintendent's office and then through their school administration and classroom teachers). All students who completed a survey were required to complete an assent form and have a consent form signed by parents prior to being given the URL for the survey. Due to circumstances beyond the control of the evaluation team, 6th grade students at Golden Hill Elementary School did not complete the student survey. At Nicolas Junior High School, students completed the surveys under the supervision of Fullerton School District's Teacher on Special Assignment (technology trainer) and the Assistant Principal to the Superintendent, as students at this school had already returned the laptops to the school for the close of the 2005-2006 school year. At the remaining two schools, students completed the surveys both at home and at school. A total of 272 surveys were completed by students and considered for this report. Table 1 shows data of returned surveys by school and participant type. It should be noted that although nine first grade students participated in the Laptops for Learning

program, no first grade students completed the survey. Data from the student surveys was used for describing student uses of laptops for learning and student opinion of the Laptops for Learning program. Additionally, student survey data was used to draw conclusions as to benefits and challenges of the Laptops for Learning program.

Table 1: Returned surveys by school

School	**Number of surveys returned**		
	Student	Teacher	Parent
Golden Hill Elementary School	0	2	39
Hermosa Drive Elementary School	59	3	83
Nicolas Junior High School	85	5	247
Robert C. Fisler School	128	16	214
Total	272	26	583

Teachers were also required to complete a consent form that requested permission for the research team to conduct observations and interviews. Only two teachers consented to be observed, yet 26 teachers participated in the evaluation by completing the survey. Data from teacher surveys was used for describing uses of laptops for teaching and learning and teacher opinion of the Laptops for Learning program. Additionally, teacher survey data was used to draw conclusions as to benefits and challenges of the Laptops for Learning program.

Parent surveys were distributed as paper surveys. Surveys were provided to all students to give to their parents. Parent surveys were returned to school with the student

and collected from the school district by the lead evaluator. A total of 583 parent surveys were returned from all schools. Table 1 shows the data of returned parent surveys by school. Surveys at Robert C. Fisler School were in both English and Korean. Thirty-one surveys were answered in Korean. The surveys at Nicolas Junior High School were provided in English and Spanish. Twenty-seven parent surveys were answered in Spanish. Data from parent surveys was used to address guiding questions 2 and 4 (*What are student, teacher, and parental opinions of the Laptops for Learning program in Fullerton School District* and *What are the benefits and challenges of continued implementation of a one-to-one laptop initiative in Fullerton School District*).

To address guiding question 3, the evaluation team analyzed school CST test scores and district discipline records. For test scores, middle school changes in CST English Language Arts (ELA) and math scores were calculated using one-way and two-way ANOVA with five different variables (factors). First, scores of students in the 1:1 laptop program were compared to scores of students not in the program. Second, students were grouped by school. Third, students were grouped by language proficiency/fluency classification. Fourth, students were grouped by ethnicity, and fifth, they were grouped by teacher.

For discipline records, data on suspensions and expulsions for the two junior high schools in the Laptops for Learning program was compared to non-program schools and compared to data from the previous years.

Findings

This section of the report provides evidence addressing the four key questions of this evaluation:

1. How are the laptops being used for teaching and learning in the Fullerton School District?

2. What are student, teacher, and parental opinions of the Laptops for Learning program in Fullerton School District?

3. How has one-to-one computing access in Fullerton School District impacted student discipline and test scores?

4. What are the benefits and challenges of continued implementation of a one-to-one laptop initiative in Fullerton School District?

These guiding questions will frame the discussion of the findings.

How are the laptops being used for teaching and learning in the Fullerton School District?

This section will discuss both student and teacher uses of the laptops. Data contributing to this section draw from the student and teacher surveys.

Student uses of laptops

Students used the laptops for a variety of purposes at school and at home during the 2005-2006 academic year. Students used the laptops in all subject areas and implemented a variety of programs. Table 2 shows the highest percentage of uses across the subject areas at home and school as reported in the 3rd - 8th grade student surveys. A lesser percentage of students responded to using the laptops for the content areas 5-6 hours per week or 7+ hours per week. It is evident that students used the laptops most frequently in Science, Social Studies and Language Arts, less frequently in Math, and barely at all in Physical Education.

Table 2: 3rd -8th grade student reported uses of laptops in content areas
(How often do you use the laptops at home and at school for [content area]?)

	Less than 1 hour per week	1-2 hours per week	3-4 hours per week	Depended on what we were doing in class
Language Arts	14%	25%	17%	59%
Math	46%	23%	5%	41%
Science	29%	29%	13%	43%
Social Studies	24%	25%	14%	45%
Physical Ed.	44%	6%	0%	43%

This data is consistent with year one data, indicating that student use of laptops remains steady. However, when asked to compare use of laptops for learning to the previous year, approximately one third of students reported they used the laptops more in year two than in year one across each of the content areas, approximately one third of students reported about the same use, and the final third were not involved in the laptop program for the pilot year (2004-2005). What is most important to note about Table 2 is the fifth column indicating that student use of laptops was dependent on what was being done in class. This could be interpreted to indicate that the use of laptops was integral to authentic learning and aligned with the curriculum rather than a forced learning tool or add-on to a learning experience.

Table 3 shows student uses of laptops at school as reported by second grade students. First and second grade students were asked about their use of the laptops in the content areas in the same way 3rd through 8th graders were, but because elapsed time is a concept that students of this age are not developmentally ready for, first and second grade students were asked to report use as *daily, couple of days a week, couple of times a month, a few times a year* or *not at all.* Students were asked in a separate question about their use of laptops for homework. This is reported in table 4.

Table 3: 2nd grade student reported uses of laptops in content areas
(How often did you use your laptop for [content area] at SCHOOL?)

	Every day	A couple of days a week	A couple of times a month	A few times a year	Not at all
Reading	15%	46%	17%	11%	11%
Math	7%	44%	20%	18%	11%
Science	2%	31%	22%	22%	22%
Social Studies	4%	26%	22%	28%	20%

When one considers that in the primary grades, class periods are approximately 45-50 minutes, this data is consistent with students in second grade predominantly using their laptops a few hours a week. No data was available for first grade. It is interesting to note that for the second grade students, the reported frequency of the laptops in Math was closer to that of other content areas than it was for the 3rd through 8th graders. This is refreshing to see, as traditionally Math is the subject in which technology is least integrated (Becker, 2001).

Table 4: 2nd grade student reported uses of laptops for homework

	Every day	A couple of days a week	A couple of times a month	A few times a year	Not at all
Homework	16%	20%	27%	27%	11%

Second grade student uses of laptops for homework showed great variation, which the evaluator feels may be attributed to several causes. First, there are four 2nd grade classes at Robert C. Fisler School, and although belonging to a professional learning community, each teacher is unique; second, as was reported in parent surveys, students have home

computers and oftentimes use the home computers at home more than they do their laptop.

Students in the Laptops for Learning program used a variety of applications on the laptops at home and at school. The most predominant use of the laptops for students in 3rd through 8th grade was for the writing process (planning, drafting, editing, revising, publishing). For the second grade students, the laptops were used less for the writing process than they were for making presentations or actually learning how to use the laptop. This is not surprising as students at this level of proficiency need more direct instruction on how to use the laptop and are still developing their keyboarding skills, whereas older students would have more dexterity and would therefore be more proficient at word processing. Both levels of students used the laptops for Internet searching, making presentations, and using district-supported software such as Comic Life (an educational application that allows students to make their own comic strips). Table 5 shows the percentage of students who reported using specific applications on at least a weekly basis. This data is consistent with student reported uses of laptops in the content areas with high frequency of use for writing (Language Arts), Internet research (Science and Social Studies), presentations (all content areas), and Comic Life (Language Arts and Social Studies). Student use of laptops for games and puzzles is one of the most commonly reported uses of the laptops in the 3rd -8th grade student survey, however only 25% of students reported this as a weekly use of their laptops in comparison to more than 60% for other applications. Although using a computer for educational games is a valid use of a laptop, it is often for review or enrichment. With this consideration, the less

frequent use of laptops for games and puzzles could also support the evaluator's opinion that the laptops were being used for authentic learning experiences.

Table 5: Percentage of students reporting using laptop applications on at least a weekly basis

Application/program	3rd -8th grade	2nd grade
Writing (planning, drafting,..)	71%	27%
Keynote/presentations	69%	49%
Internet research	63%	51%
Comic Life	35%	27%
Games and puzzles	25%	29%

Other reported uses of laptop application on at least a weekly basis varied between the two groups of students. Third through 8th grade students reported using laptops for online tests and quizzes (32%), Note Taker (31%), BrainPop (32%) (online short movies for science and social studies), and My Access! (29%) (online writing and editing tool used by middle school students in the district). Second grade students reported watching movies (Fullerton School District subscribes to United Streaming, an online database of educational videos) (42%) and learning something new about the laptop (40%).

Both groups of students reported using the laptops to work with partners or in small groups: 3rd-8th grade 35% and 2nd grade 49%. Research suggests the most effective technology integration in K-12 classrooms is when a constructivist approach to teaching and learning is adopted (e.g., Anderson & Dexter, 2003; Becker, 2001; Sandholtz, Ringstaff, Dwyer, 1997). Hence, the fact that students in all grade levels are working on projects in groups or with partners is commendable and in alignment with best practice for technology-rich learning.

Student reported uses of laptops for learning is supported by teacher survey data. Teachers were asked a similar question to students about the use of specific applications on at least a weekly basis. Table 6 shows the percentage of teachers who reported that their students used the specific applications at least once a week.

Table 6: Percentage of teachers reporting on student use of specific application on a weekly basis

Application/program	Percentage of teacher respondents
Writing (planning, drafting,..)	96%
Keynote/presentations	85%
Internet research	96%
Comic Life	54%
Laptop functions	50%
Note Taker	58%
Games or puzzles	58%
Online tests and quizzes	50%
Downloading movies or videos	38%

Additionally, 69% of teachers reported having their students keep a homework planner or calendar on the computer. This is consistent with and supports student data responding that having a laptop helps the student to stay more organized (88% of 3rd-8th graders strongly agreeing or agreeing) and parent data reporting that they feel their student is more organized with the laptop (74% agreeing either slightly, strongly, or simple agreement).

Student uses of the laptops at home are considerably different than at school, possibly indicating that students are truly of the digital generation in that using a computer is a natural part of their daily routines. Student uses at home center on entertainment, with the most common use reported by 67% of 3rd through 8th grade students being listening to

music, 56% reported surfing the Internet, and 39% reported playing games. Second grade students were asked more general questions about home laptop use. Students were asked to respond *yes, no,* or *sometimes* to whether they used the laptop for playing games, playing on the Internet, and finding information on the Internet. Table 7 shows their responses to these questions.

Table 7: Percentage of 2nd grade students who responded to using the laptop at home for specific purposes

Home use of laptop	Percentage of student responses		
	Yes	No	Sometimes
Playing games	20%	27%	53%
Playing on the Internet	20%	39%	41%
Finding information on the Internet	50%	20%	30%

In summary, students used the laptops for a variety of purposes both at school and at home. Students used the laptops in all content areas, however Language Arts, Social Studies, and Science are the most commonly assigned content areas. Students used a range of applications, with the writing process being reported by the most students as a weekly use of the laptops. Similarly, students used presentation applications such as Keynote and I-movie, the Internet for research, and Comic Life. A lesser percentage of students reported using the laptop for games or puzzles while at school. Student reported data is supported by teacher reported data. At home, students are demonstrating 21st century skills and used the laptops for completing homework, listening to music, and surfing the Internet.

Teacher uses of laptops

A total of 26 teachers responded to the teacher survey. Teachers ranged in their teaching experience from novice teachers to teachers with over 20 years of experience and represented all grade levels from 1st through 8th. Fifty-eight percent were involved in the laptop program during year one and 42% were new to the laptop program in year two. In addition to assigning students to use the laptops for learning experiences, teachers used the laptops for a variety of professional and managerial purposes.

Teachers reported using the laptops for lesson preparation, assessing students, and communicating with colleagues, parents and students. Table 8 shows teacher responses to the question asking them to report on the frequency with which they used their laptop for each of these purposes. It is evident teachers used the laptops as an integral part of their teaching day. Additionally, teachers are becoming more reliant on the use of the laptops for teaching as is evidenced by their reporting that they used the laptops more in year two than in year one. On average, approximately 46% teachers reported using the laptops for the above purposes more in year two than in year one. Approximately, 27% of teacher reported the same amount of use and the remaining 27% (approx.) were not involved in the laptop program during year one. It should also be noted that teachers are discussing the use of laptops for teaching and learning with colleagues and friends. Twenty-eight percent of teachers reported discussing laptops or educational software, teaching websites and lesson planning on a daily basis, and an average of 30% responded to discussing these topics several times a day.

Table 8: Percentage of teachers reporting use of laptops for specific purposes

	Never	< Once a week	Weekly	Several times a week	Daily
Look up information	0%	0%	4%	8%	88%
Lesson preparation	0%	4%	8%	23%	65%
Assess student work	1%	12%	12%	42%	27%
Monitor student progress	0%	12%	12%	31%	46%
Communicate with colleagues	0%	0%	4%	8%	88%
Communicate with students	4%	27%	12%	27%	31%
Communicate with parents	0%	19%	19%	35%	27%

Teachers also used the student applications and reported feeling more proficient with them. When asked about their level of proficiency with certain applications or uses of laptops for teaching, the majority of teachers responded they are more proficient. Table 9 shows this data. Other teachers reported a level of proficiency about the same as in year one, with a minimal number of teachers reporting feeling less proficient (12% felt less proficient with United Streaming and Note Taker). What is important to note about the data in Table 9 is the high percentage of teachers who feel more proficient at selecting appropriate programs to meet learning goals and developing Internet-based and project-based learning experiences. When considering the instructional evolution model (Sandholtz, Ringstaff, & Dwyer, 1997) in which teachers move along a continuum of trying to fit the technology into existing practices toward using technology naturally and

purposefully, teachers involved in the Laptops for Learning program could be placed at the appropriation stage (using computers naturally and purposefully).

Table 9: Percentage of teachers who feel more proficient at using laptops for specific purposes in year two than in year one of the laptop program

Use of laptop	Percentage of teacher respondents who indicated feeling more proficient
Using Power Grade	46%
Navigating the Internet	58%
Preparing a slide show or presentation	73%
Editing digital movies	58%
Using United Streaming	65%
Using Comic Life	88%
Using Note Taker	73%
Using web-based learning sites (e.g., Explore Learning, Beyond Books)	69%
Selecting appropriate programs to meet learning goals	80%
Developing Internet based lessons	81%
Developing project-based lessons	85%

In summary, teachers in the Laptops for Learning program used the laptops for a range of teaching and managerial purposes. Teachers planned technology based lessons and implemented district provided software and the Internet. They used the laptops to communicate with colleagues, prepare lessons, and assess students. Additionally, teachers became more proficient at using their laptops, which will ultimately result in a trend to use the laptops for authentic teaching and learning on a regular basis.

What are student, teacher, and parental opinions of the Laptops for Learning program in Fullerton School District?

This section discusses the student, teacher and parental opinions of the Laptops for Learning program. Data from student, teacher, and parent surveys will inform this section. Student, teacher and parental opinions will be addressed individually.

Student opinions of Laptops for Learning program

Students had overall positive opinions of their involvement in the Laptops for Learning program. Students felt that the laptops assisted them in their school work and contributed to school success. Students as a group preferred to use their laptops over not using them, and felt that having a laptop contributed to more involvement in school.

An overwhelming majority of students in grades 3 through 8 reported that school was more interesting since beginning the Laptops for Learning program. This is relevant in an educational era when so many students are feeling a disconnect from school and academics (Apple, 2004). Figure 1 shows the percentage of 3rd through 8th graders who agreed in varying degrees to questions about their opinions of the Laptops for Learning program.

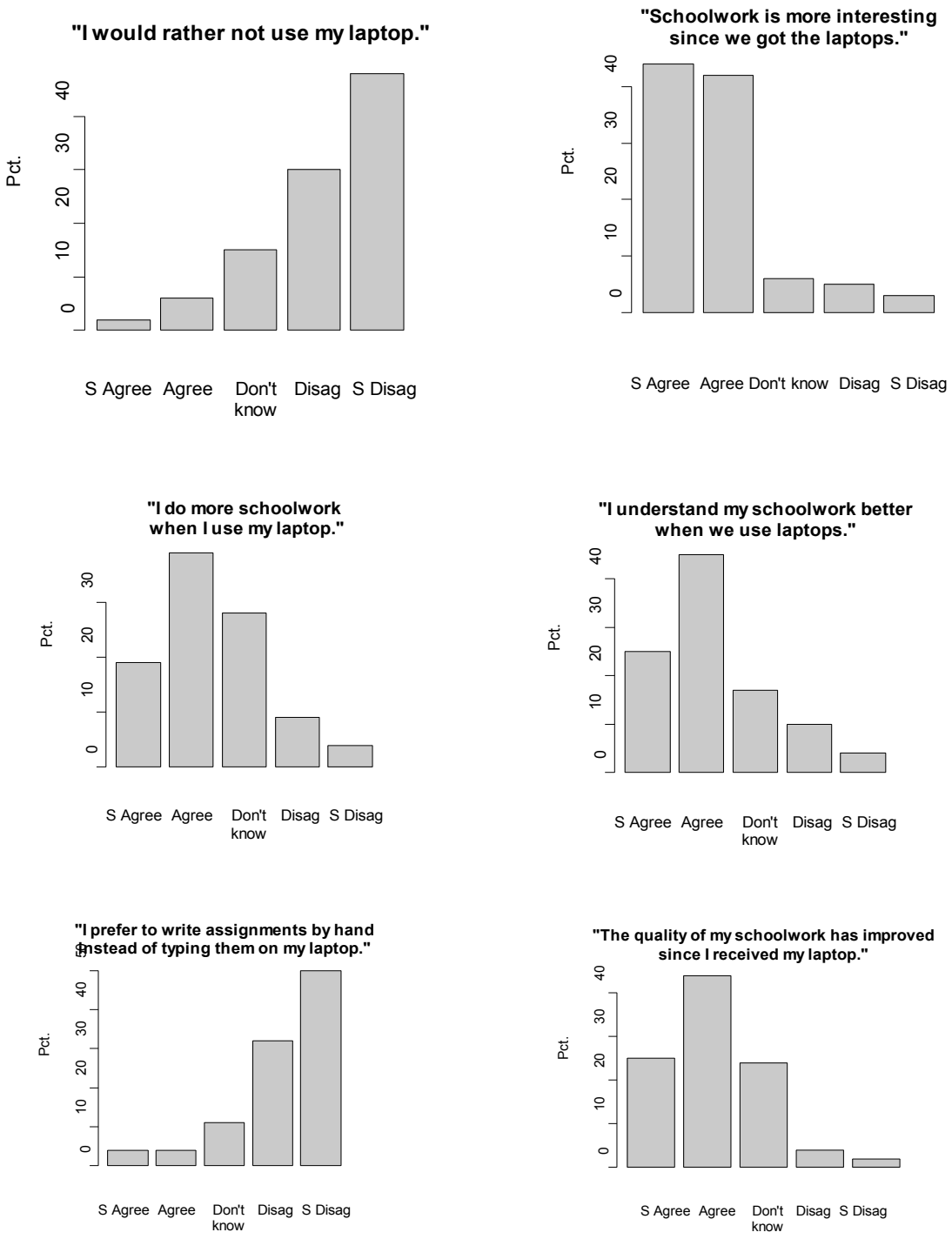

Figure 1: 3rd-8th grade student responses to questions about their opinion of the laptop program.

The positive opinions about the impact of involvement in the Laptops for Learning program were echoed by students in second grade who completed the survey. Table 10 shows second grade student responses to questions about their opinion of the laptop program.

Table 10: Second grade student opinions of Laptops for Learning program involvement

	Yes	No	I don't know
Do you think having a laptop made school more interesting?	84%	5%	11%
Would you like to have a laptop next year?	80%	9%	11%

It is clear from Figure 1 and Table 10 that students had positive opinions about the laptop program. Student opinion of the laptop program is best illustrated in student comments in response to *what is the best thing about having a laptop?* Student responses to this question ranged from naming specific things that can be done on the laptop such as playing games to more general responses such as getting to learn about more things. Comments such as these illustrate the pride these students have in their involvement with the Laptops for Learning program:

> I could have an early start of learning about computer technology. I have so many friends who don't know how to use computers, but I am so lucky to learn how to use a computer at school

and

> I am more advanced for the real world and I think I am more ready for the world than my mom or dad ever was. My friends that go to X school are amazed at the things

> I can do with my laptop and are thinking of transferring for that reason

These comments also highlight the fact that students see their involvement in the program as preparing them for 21st century living. Other student comments refer to the ease and convenience of digital learning over traditional learning:

> It is easier than writing final drafts,
>
> The best thing is when nobody helps you, you could do it on the computer
>
> I get an idea of what we are working on in class and with our projects there is really no limit to what we can do

There were comments such as "the best thing is that the tv people come to visit us and interview us" that could be interpreted as being a 'novelty effect', however these comments were far outnumbered by others indicating more authentic learning.

Although expressed as a concern, several students shared their positive opinion of the laptop program by commenting that one bad thing about the laptop program was having to return the laptop over the summer or that there were some people who didn't want them to have the laptops. Other students wrote positive comments when asked if there was anything else they would like to share:

> I think that more schools should have this program because it is more beneficial to our learning
>
> This has been a wonderful experience and I would love to continue doing it
>
> The laptop program is overall great

Despite the many positive opinions of the Laptops for Learning program, students also shared concerns. Many students expressed concern over having to care for the laptop

and the weight of the laptop. Other students were concerned about the degree with which the laptops were controlled by the school, expressing:

> The one thing that I don't like about the laptops is the limits they have on them
>
> The system blocks us from doing fun stuff

Additionally, students had concerns about the operating system of the laptops, referencing laptop speed, freezing, and other technical issues:

> My mouse goes out of control
>
> Sometimes with the laptops something may be deleted, or there could be a problem with the computer
>
> When the laptop freezes and I have to restart the laptop and my work isn't saved and when too many people get on the certain program and the program shuts down or the Internet or dropbox aren't working
>
> I would rather have a more updated laptop

In summary, students had positive opinions about the laptops. Technical issues and concerns about the weight of the laptops are genuine concerns and will be addressed in the discussion of challenges and/or recommendations.

Teacher opinions of Laptops for Learning Program

Like students, teachers had overall positive opinions of the Laptops for Learning program. Many teachers (81%) recommended the program be continued at their school site and 81% recommended that the Laptops for Learning program be extended to other school district schools, indicating a positive opinion with the program. As a group, teachers were comfortable with the technical and instructional support and reported the

Laptops for Learning program had a positive impact on their teaching and professional practice.

Table 11 shows percentage of teacher responses to survey questions about the impact of the laptops on their teaching practice. It is evident from this table that teachers felt having laptops positively impacted their teaching practice. Teachers overwhelmingly agreed that having laptops allowed for more individualized instruction which may contribute to why students feel more positively about school since the Laptops for Learning program began. Additionally, a range of responses to the question about teachers wanting more support to integrate the laptops into teaching and learning may be a result of the range of teaching experience and current levels of proficiency with using a laptop. This is an important consideration as the school district plans continued professional development.

Table 11: Teacher responses to questions about their opinions of the Laptops for Learning program

	Strongly agree	Moderately agree	Neutral	Moderately disagree	Strongly disagree
My teaching is more effective with laptop use	68%	28%	0%	0%	4%
I am better able to individualize my instruction as a result of having laptops.	62%	27%	4%	4%	0%
I would like to have more support on how to integrate the laptops into teaching and learning.	19%	31%	23%	8%	19%

More specifically, teachers reported that the Laptops for Learning program positively impacted their ability to differentiate their instruction, their ability to create and

implement integrated or cross-curricular lessons, and their overall self-efficacy as a teacher. Table 12 highlights the percentage of teachers who responded to questions about the impact of the laptops on specific elements of their teaching practice. It should be noted that one teacher felt that having laptops had negatively impacted classroom management, a common phenomenon when a new instructional tool is introduced into the teaching and learning environment (Sandholtz, Ringstaff, & Dwyer, 1997). It should also be noted that teachers reported the laptops had a positive impact on their ability to coach more and lecture less. This, strategy, indicative of a constructivist teaching philosophy, is supported by the fact that teachers assigned more project-based learning. This is a positive finding because it illustrates that teachers used strategies that have been reported as effective for teaching in a digital environment (Becker, 2001; Sandholtz, Ringstaff, & Dwyer, 1997).

Table 12: Teacher responses to survey questions about laptop impact on specific teaching practices.

	Negatively	Neutral	Slightly positively	Positively	Very positively
Differentiating instruction	0%	12%	8%	27%	54%
Coach more, lecture less	0%	15%	15%	27%	42%
Creating and implementing integrated / cross curricular lessons	0%	12%	8%	31%	50%
Classroom management	4%	31%	8%	27%	31%
Self-efficacy as a teacher	0%	19%	4%	31%	46%

(Teachers were also given the option of reporting slightly negatively or very negatively, yet for all items these options were 0%)

Perhaps the most important data to report is the way teachers felt the laptops assisted the different types of learners in the classroom. Table 13 shows data on teacher's

responses to a question about their opinion of how the laptop program assisted different learners. It is clear that teachers felt very positively about the impact laptops had on all learners. This is important to note as we consider the need to meet the needs of all learners. It is apparent from Table 13, that teachers felt the most positive impact of the Laptop for Learning program lay with the Gifted students. This is not surprising, as gifted students are often more independent learners and the gifted program lends itself well to project-based learning. It should be noted that for all learning groups, a minimum of 80% of teachers felt that the laptop program had a positive impact.

Table 13: Teacher opinions of the impact of laptops on meeting the needs of different learners

	Very Negatively	Negatively	Neutral/ no impact	Positively	Very positively
English Language Learners	0%	0%	16%	40%	44%
Special Education	0%	0%	16%	48%	36%
Gifted	0%	0%	12%	12%	72%
At-Risk	0%	0%	20%	28%	52%
General Ed. - No special needs	0%	0%	12%	40%	48%

Perhaps the best way to sum up teachers' opinions of the laptop program is to use the words of the teachers:

> After my experience this last year I could not imagine going back to teaching without laptops. The children are exposed to so much more than I could ever give them alone.
>
> Teaching with laptops has made teaching and learning exciting, fulfilling, and motivating.
>
> I am empowered as an educator when my students have laptops.

> The laptop program has really enhanced our classroom learning. Technology is the wave of the future and we are really preparing our students earlier for what is inevitably going to be their future.

Teachers, like students had an overall positive opinion of the Laptops for Learning program however they were not without questions and concerns. Many concerns stemmed from technical difficulties. Teacher comments such as:

> Too many broken computers - many students had to share to make a lesson work.
>
> More technical instruction is necessary.

highlight this concern. Additionally, when asked about what kind of professional development they would like to receive, several respondents requested training on using the laptops to better meet the academic content standards. This is a genuine concern and an important consideration for the school district. In an educational environment that stresses standards-based instruction these teachers are looking for ways to address standards and accountability while pursuing their passion to teach with technology.

Parent opinions of the Laptops for Learning Program

Parent opinions of the Laptops for Learning program echoed those of the students and teachers, with the majority of parents who completed the survey having positive opinions about the program. In addition to being asked their opinion of the Laptops for Learning program, parents were asked about home Internet access and use of the laptops in the home.

Eighty-one percent of students in the Laptops for Learning program have home Internet access; either high speed Internet access in the form of cable or DSL (53 % of the 81%), free wireless through the City of Fullerton (11%), or through a dial-up connection (12%). Table 14 shows percentage of parents who reported home Internet access as well as percentages of types of student home Internet access by school. It does not, however, account for siblings at the same school returning parent surveys.

Table 14: Student home Internet access by school as reported by parents

	Golden Hill Elementary School	Hermosa Drive Elementary School	Nicolas Junior High School	Robert C. Fisler School
No Internet access in the home	7%	3%	37%	2%
Home Internet access	86%	96%	63%	98%
Don't know or no answer	7%	1%	4%	<1%
Dial-up Internet access	17%	2%	15%	11%
High Speed Internet access	60%	77%	36%	71%
City of Fullerton wireless access	5%	16%	9%	16%

Totals may add not add to 100 due to rounding

It is evident from this table that there is great variation in home Internet access and speed across the four schools. There is similar variation in the number of computers in the home besides the student's laptop. These are both important considerations for school district personnel as they plan homework assignments, parent communication, and other school-home connection activities. This data may also influence parent opinion of the Laptops

for Learning program as home computer and Internet access could be representative of the degree of 21st century environment in the home.

Overall, parents expressed positive opinions of the Laptops for Learning program, as is evidenced by their desire to send their child/children to middle or high schools with one-to-one programs. Figure 2 illustrates this.

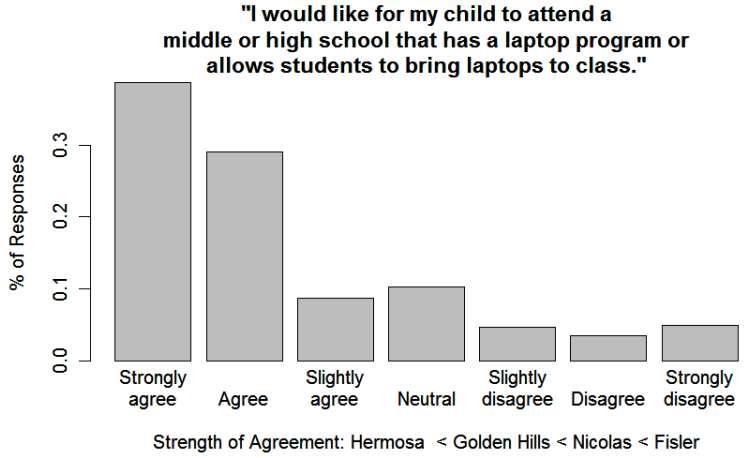

Figure 2: Parent responses to question about sending children to middle or high school with laptop program

This figure represents the average response across all four schools. When considering this figure, one must take into consideration that some students (at Robert C. Fisler School) were at a school that already has a one-to-one program at the junior high school grades (6-8), and that different numbers of parents from each school returned the surveys. Table 15 shows parent responses to this question by school. It is still clear that the majority of parent respondents at each school favor sending their child to a middle or high school with a one-to-one laptop program.

Table 15: Number of parent respondents to question about sending students to middle or high school with laptop program as reported by school.

School	Strongly Agree	Agree	Slightly Agree	Neutral	Slightly Disag.	Disagree	Strongly Disagree
Fisler	76	72	32	32	16	7	11
Nicolas	97	82	14	20	10	12	12
Golden Hill	18	8	4	4	1	0	5
Hermosa	48	17	4	8	2	3	3

Kruskal-Wallis chi-squared = 14.6399, df = 3, p-value = 0.002152

Additionally parents' positive opinion of the laptop program is evident in the large percentage of parents who reported they feel having a laptop will positively impact their child's academic future. Figure 3 illustrates this.

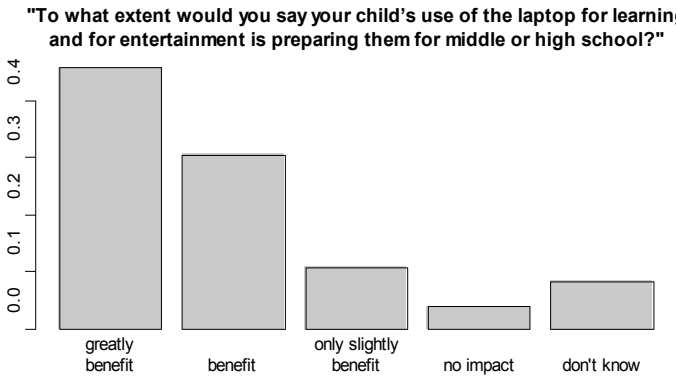

Figure 3: parent opinion about impact of laptop program on child's academic future

Once again, this is an average of all parent responses and is not reported by school. Table 16 shows this data by school.

Table 16: Parent responses to question about the laptop preparing students for middle or high school

	Golden Hill Elementary School (N=39)	Hermosa Drive Elementary School (N=84)	Nicolas Junior High School (N=244)	Robert C. Fisler School (N=224)
Greatly benefit	87%	86%	73%	77%
Benefit	0%	<1%	9%	<1%
Slightly benefit	13%	10%	9%	16%
Not impact	0%	4%	9%	7%
I don't know	0%	0%	0%	0%

To further illustrate the positive opinion of the laptop program, we can examine parent responses to the survey question about the continuation of the laptop program at each of the schools. Figure 4 shows the average response to this question across all four schools, while table 17 shows this data by individual school.

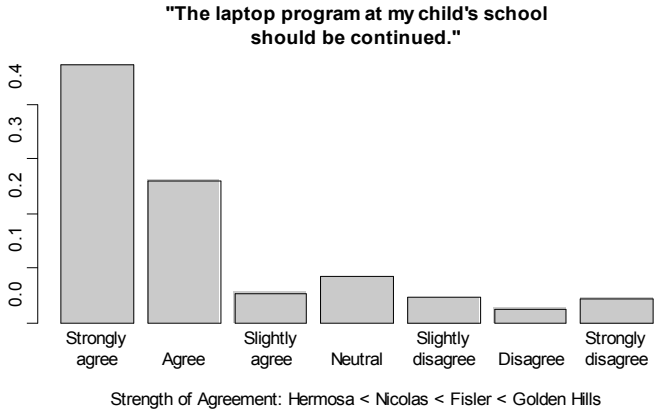

Figure 4: Parent responses to item regarding continuation of laptop program

It is clear that there is an overwhelming agreement by parents who completed the survey that the laptop program should be continued. The majority of parent respondents from all schools reported strongly agreeing to this item.

Table 17: Parents responses to item regarding continuation of laptop program by school

School	Strongly Agree	Agree	Slightly Agree	Neutral	Slightly Disag.	Disagree	Strongly Disagree
Fisler	100	64	16	21	15	7	9
Nicolas	112	70	12	16	9	6	14
Golden Hill	17	9	2	4	3	2	3
Hermosa	54	14	3	10	2	1	2

Kruskal-Wallis chi-squared = 9.2514, df = 3, p-value = 0.02613, N = 597

Parents' opinions of the Laptops for Learning program is perhaps best represented in this report by the comments they made on the one open-ended survey question asking if they had any further comments about the program. As with the students and teachers, parents had many positive comments to share. Parents commented on how the program will benefit their child, how it has positively impacted the child's attitude toward school, and the way the laptop program is helping with academics and preparing children for the future:

> My child's first year in the laptop program taught excellent skills of responsibility and language. My child used the laptop to write essays and no longer required extensive parental editing in order to write grammatically correct. (Hermosa Drive parent)

> This has been the best program for my son. He actually likes school and using the laptop made him interested in learning. (Nicolas parent)

> My child has learned an incredible amount this year using her laptop. Her self-esteem has grown and her ability to research has developed immensely. I believe her access to laptops and taking it home has increased her study habits. She has learned to scan and read information, check for accurate information, and feels confident researching anything. (Fisler 3rd grade parent)

> I strongly believe the laptop program is a success and seeing my child develop her skills to use her laptop makes me feel that she is being prepared for the future. (Fisler 2nd grade parent)
>
> I strongly support the laptop program. The results for my child this year have been improved writing skills, enhanced creativity and a strong confidence in computer skills overall. The program has definitely benefited my child. (Golden Hill parent)

Other parent comments centered on a desire to continue the program and expand it to middle schools and high schools.

Although a large majority or parents' comments expressed positive opinions of the program, not all their comments were positive. Parents had genuine concerns about technical issues, the role of the parents including cross-platform issues, and the cost of the laptop. For example:

> I feel strongly that they should be using MS Word since it is the dominant word processing program. (Golden Hill parent)
>
> The laptop malfunctioned most of the year even after being repaired several times. It was frustrating because homework had to be done more than once because of hardware malfunctions. (Nicolas parent)
>
> I believe there should be more homework utilizing the computer if we were to keep paying for the lease program. Last year alone there were only a few occasions where my daughter used the laptop for school purposes. (4th grade parent)
>
> My child was often concerned more with certain software such as i-movie that the subject matter was totally compromised. (4th grade parent)
>
> I have a PC background, she has an Apple. I couldn't help her much. … It was difficult to get a wireless connection downtown this year and also she developed poor study habits (lying about doing homework). (4th grade parent)

Other concerns centered on student inappropriate use of the laptops which will be discussed in a later section of this report (Challenges and benefits of the program).

In summary, parents generally had positive opinions of the Laptops for Learning program, however they also had genuine concerns. Positive opinions were expressed in an overwhelming agreement that the laptop program should be continued, the agreement that the program benefited the students' educational future, and the desire to send students to middle or high schools with laptop programs. Concerns centered on technical issues, cost of the laptop, inappropriate use of the laptops by students, and cross platform issues.

How has one-to-one computing access in Fullerton School District impacted student discipline and test scores? (Detailed attendance records were not available for analysis.)[1]

Disciplinary actions

Disciplinary actions during the past three school years present a mixed picture for the Laptops for Learning program. As can be seen in Table 18, the total number of suspensions in Fullerton middle schools fell sharply in both years of the laptop program, declining 33% between 2004 and 2005, and another 35% between 2005 and 2006. Expulsions fell from 7 to 0 between 2004 and 2005, then rose to 6 in 2007.

[1] This section of the report was written by Douglas Grimes.

Table 18

FSD Middle School Disciplinary Actions, 2004 - 2006

	Suspensions			Expulsions		
School/Year	2004	2005	2006	2004	2005	2006
Fisler	N/A	0	5	N/A	0	0
Nicolas*	122	68	82	4	0	3
Laptop Schools	122	68	87	4	0	3
Beechwood	N/A	N/A	5	N/A	N/A	0
Ladera Vista*	313	208	50	3	0	1
Parks	83	74	35	0	0	2
Non-LT Schools	396	282	90	3	0	3
District Total	518	350	177	7	0	6
Laptop % of Total	24%	19%	49%	57%	N/A	50%

In the first year of the laptop program, the percentage of total suspensions contributed by the two laptop schools, Nicolas and Fisler, fell from 24% to 19%. In the second year of the program the pattern was strongly reversed, with the laptop schools contributing 49% of district suspensions. At least four factors complicate interpretation of the increase in disciplinary actions in 2006. First, two schools, Nicolas and Ladera Vista, got new principals who may have had different disciplinary policies than their predecessors. Second, the way suspensions were reported also fails to distinguish between different levels of suspensions, such as in-school and at-home suspensions. Third, expulsions were too few to establish clear patterns, either overall or for comparing laptop and non-laptop schools. Fourth, it would be more meaningful to report

disciplinary actions as a percentage of enrollment, but data on prior years' enrollment was incomplete.

In spite of these limitations in the available data, the sharp upturn in suspensions in the second year of the laptop program undermines claims of benefits of the laptop program on student discipline.

California Standards Test (CST)

CST scores for students who were 7th and 8th graders in 2006 were analyzed for changes that might be related to the Laptops for Learning program. Change was measured by the difference in matched cohort scores between 2006 and 2005, when most of students were 6th and 7th graders. The matched cohort approach avoids variation due to year-to-year changes in the student population. Elementary grades were not analyzed because of the unavailability of data on which students were in the laptop program. In order to place potential changes due to laptops in the context of other factors which might also correlate with improvements or declines in CST scores, one-, two-, and three-way ANOVAs (analyses of variance) were performed on five factors (qualitative variables): laptop status, school, language fluency, ethnicity, and teacher. Since the focus of this report is the impact of laptops, only those findings directly related to laptop status are summarized in this section. An extended analysis of all five factors appears in the appendix.

ELA scores changes improved an average of 1.2 points more in the two laptop schools (Nicolas and Fisler) than in the other three schools with 7th and 8th grades (Ladera Vista, Parks, and Beechwood), a statistically insignificant difference. In contrast, the 10.5 point difference in math score changes was highly significant. (They rose an

average of 4.8 points in the two laptop schools and fell an average of 5.7 points in the non-laptop schools.) However, the difference was entirely due to improvement in the mean scores for Nicolas students; the mean math score for Fisler students actually fell (Table 19). Since laptops were used little in math classes, the difference between laptop and non-laptop schools cannot be attributed to the laptop program.

Table 19
Change in CST Scores, 2005 to 2006
FSD Middle Schools (N = 2,689)

	ELA	Math
Beechwood MS	17.5	-20.9
Fisler MS	14.1	-4.9
Ladera Vista	4.4	3.6
Nicolas	5.7	6.2
Parks	6.2	-13.6
District Mean (Weighted Ave.)	6.0	-1.8
Mean, Laptop Schools	6.8	4.8
Mean, Non-Laptop Schools	5.6	-5.7
Difference in means	1.2	10.5
95% confidence interval for true difference in means	-1.2 to -3.5	7.2 to 13.7
p (probability that true difference in means is not = 0)	.32	$2.7\ e^{-10}$

CST ELA and math scores thus provide no evidence of either enhanced or diminished learning through the Laptops for Learning program. This lack of improved test scores is consistent with laptop programs elsewhere and should not be taken as indicating no educational value to the program (Warschauer, 2005, 2006). When combined with the overwhelmingly positive findings of the surveys, these findings suggest that the types of learning fostered by laptops are not measured by the CST. For example, the surveys collectively indicate improved technology skills, increased collaboration among students, and more constructivist teaching practices with the laptops, none of which are assessed

by the CST. In addition, students' increased organization and interest in learning is likely to translate into enhanced academic performance over the long term.

What are the benefits and challenges of continued implementation of a one-to-one laptop initiative in Fullerton School District?

There are many benefits to the Laptops for Learning program and many challenges as well. Several benefits of this program including preparing students for 21st century citizenship, enhancing computer literacy, and showing positive effects on student writing a are not unique to Fullerton School District but are benefits of laptop programs worldwide and have been reported in educational journals (Penuel, 2006). In order for benefits unique to Fullerton School district to be isolated, more research is necessary, perhaps in the form of case studies of individual students as they progress through their school years and into the workforce. Research might also identify challenges, solutions, and benefits of laptops specific to Fullerton School District.

Perceived benefits of the Laptops for Learning program stem from the positive opinions of the program and the varied uses of the laptops by students and teachers. Teachers are becoming digital educators and are using teaching strategies consistent with 21st century skills and best practice. By naturally integrating the use of laptops into the learning experiences of students, teachers are promoting students' ability to think and learn with technology, skills that will be necessary for their academic and professional futures.

In educational circles it is well understood that we should no longer be teaching students about computers, but students should be learning with them. This is definitely occurring at the four laptop schools in Fullerton School District, as is evidenced by

parental opinion of their children being proficient with laptops and student comments about their own proficiency. When asked in the student survey, what is something you are really good at, many students spoke freely about their technological proficiency with using the various applications such as i-Movie, researching using the Internet, and fixing the computer. Some students even expressed that the best thing they could do on the computer was help other people.

As has already been discussed in this report, an additional benefit of the Laptops for Learning program is the program's impact on teaching practice being aligned with constructivist pedagogy. Constructivist pedagogy allows for students to be independent learners seeking their own knowledge, working as a part of a group and applying knowledge to solve problems. These are skills that will prove invaluable in each student's future. As was reported by teachers, all student groups were benefiting from the Laptops for Learning program.

Although not unique to Fullerton School District, but clearly expressed in parent surveys is the impact having a laptop had on students with special needs. Parent comments illustrate this:

> My child has grapho-motor skills trouble. Utilizing the laptop has increased his writing output ten-fold. (Hermosa parent)
>
> For my child who has autism this was an extraordinary tool and allowed for better grades (3.8 GPA!) and a more positive experience than I anticipated. (Nicolas parent)
>
> The laptop program has been an invaluable tool for our son these past two years. He has a diagnosis of "disorder of written expression" that co-exists with a diagnosis of autism, high-functioning. The laptop was equipped with additional software programs as recommended by ATEC evaluation and the laptop with combined software programs improved

> his ability to learn as well as enabled him to significantly improve the quality of work he would produce. (Fisler parent)
>
> [My child] is in RSP and has always struggled with school. This year has seen miraculous change in her attitude toward school and homework. (Hermosa parent)

No innovation is without challenges and the Laptops for Learning program is no exception. There are many challenges that the Fullerton School District should address if the program is going to be a continued success. Recommendations for addressing these challenges will be made in the recommendations section of this report. Challenges of the Laptops for Learning program include maintaining and updating laptops, technical support, inappropriate use of the laptops by students, and managing the cost of the laptops for parents.

Perhaps the primary challenge faced by Fullerton School District and the Laptops for Learning program is with regard to the cost of the laptops. It should be noted that this evaluation was conducted during a time when the Fullerton School District was in negotiation with the ACLU about having a parent-funded one-to-one computing initiative. Figure 5 illustrates parent opinion when asked about the cost benefit of the laptop.

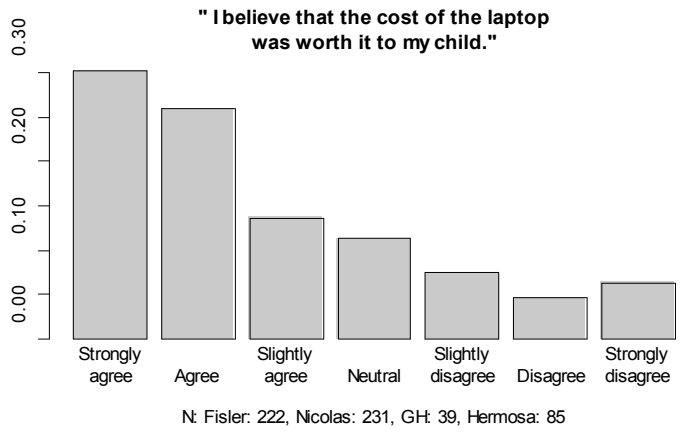

Figure 5: Parent responses to question about cost of laptop

Even though there was variation by school (see table 20), it is evident that parents felt the cost of the laptop was worth it. However parent comments were very strong and we must understand that this report is only representative of those parents who returned the survey.

Table 20: Parent responses to question about cost of laptop by school

School	Strongly Agree	Agree	Slightly Agree	Neutral	Slightly Disagree	Disagree	Strongly Disagree
Fisler	49	52	48	30	21	10	12
Nicolas	68	77	19	26	14	10	17
Golden Hill	15	5	5	2	4	5	3
Hermosa	43	16	7	8	4	2	5

Kruskal-Wallis chi-squared = 17.5836, df = 3, p-value = 0.000536

Parent comments on this issue covered both sides with many parents expressing that the laptops should be free and others sharing that the perceived benefits of the laptops outweigh the cost:

> It has been great for us to give this program to our daughter.
> But if we stop and think about it the cost is a little high.
> We as working parents are making a great effort to keep

her with her laptop. (Hermosa parent)

We thought the ACLU complaints were silly because the school allowed income challenged families to apply for a waiver. The $75 to rent the computer was reasonable. (Nicolas parent)

If the school district makes it mandatory for a child to use, they should pay for it. We were uncomfortable having our 7th grader having an expensive item in their possession. (Nicolas parent)

Spending $1500 on a computer cannot compare to the lifetime benefits received. (Fisler parent)

Other challenges of the Laptops for Learning program stem from technical issues. Figure 6 shows parent responses to survey question regarding the technical support of the program.

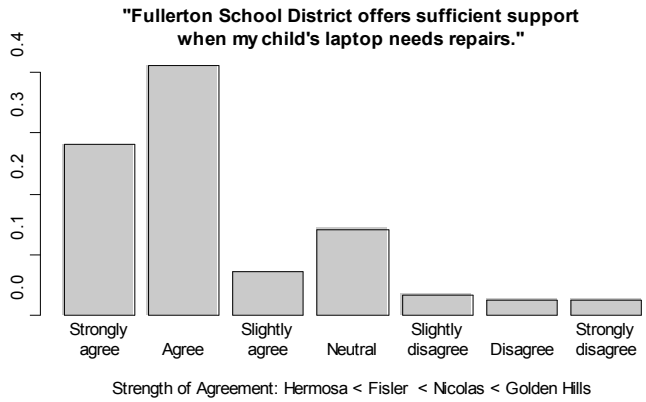

Figure 6: Parent opinions of technical support

This figure shows overall opinion of support, which is positive, however many parents and students reacted to the technical issues of the program in the comment section of the surveys:

Repairs to laptops need to be done in more timely basis. My son's laptop had nothing but problems since the beginning of the school year. He had to do more homework assignments over

> more times then suffered lower grades because the machine wouldn't work and the teacher wouldn't accept the homework any other way. (Golden Hill parent)
>
> When the computer wasn't functioning properly, her grade was bumped down for work not being ready. (Golden Hill parent)
>
> The program was okay, but the computer kept breaking down and it took forever for my child to get back the computer which made him fall behind in his homework. (Nicolas parent)

A related challenge faced by the continuation of the Laptops for Learning program, although not expressed by many, is the need for continual updating of the laptops and the applications installed on them.

Other challenges of continued implementation of the Laptops for Learning program are relative to access to the Internet. As was evidenced in the parent survey question reporting home Internet access (Table 14), there was considerable variation within and across schools with regard to home Internet access. This is a challenge that should be addressed by the Fullerton School District in order to bridge the digital divide and not contribute to it.

A challenge of the Laptops for Learning program that was highlighted in student and parent comments about the program centers on the administrative rights of the laptops. Where many students expressed frustration that they couldn't download more things, access more websites and use the computer for more games, parents expressed concerns that students had too much access to the Internet and too many games. There were some parents who wanted to be given administrative rights for adding stronger filters or adding home printers and others who wanted to have the administrative rights to allow more open Internet access. The challenge faced by the school district with this dichotomy is to

find the balance between who has control and how much control of the laptops schools and families have.

A final and very serious challenge that will need to be addressed by the Fullerton School District is that of inappropriate use of the laptop and the Internet by students. As we enter a more digital era and students are increasingly comfortable with technology and the Internet, Internet safety must be addressed. Although some parents felt that the district was doing a good job of teaching students Internet safety, others had concerns about their child's reliance on the laptop for entertainment. Parents expressed concern about student's becoming too dependent on the laptop and not practicing penmanship or getting enough exercise. However, the biggest challenge in this area is that related to Internet safety. It cannot be stressed enough by parents and schools that students must be aware of the hazards of communicating with people via the Internet. Recommendations for addressing this will be made in the Recommendations section.

In summary, challenges and benefits of the Laptops for Learning program are numerous, but not unique to one-to-one programs. Perceived benefits include the 21st century learning environment which promotes independent knowledge seeking and group work, both skills valuable for functioning in a 21st century environment and meeting the needs of learners with special needs. Challenges faced by Fullerton School District include technical issues, Internet safety, and finding a balance between financial and administrative contributions of parents and the school district.

Conclusions

Fullerton School District should be commended on its successful second year implementation of the Laptops for Learning program. Based on this evaluation data, the program continues to be well received by parents, teachers, and students. The majority of respondents to the surveys in this evaluation reported positive opinions of the program and support its continuation.

Students and teachers in the four Laptops for Learning schools were learning and teaching in a 21st century environment. This environment naturally integrated the student laptops into the learning experience. The laptops were one of the many teaching and learning strategies implemented in the classroom, as evidenced by the degree with which the laptops were used within the content areas. Using laptops in this way shows that learning with the laptops became a 'part of life' and not a novelty or a class that students took. This is further supported by the student use of the laptop in the home environment. Students used the laptops for both school work and entertainment in the home. Although many parents had concerns about student reliance on the laptop for entertainment and the laptops being a distraction to homework, students of today are a digital generation and are fully accustomed to fast paced technology, multi-tasking, and using digital tools for daily functioning (Apple, 2004).

Fullerton School District is facing several challenges as a result of continued implementation of the Laptops for Learning program. None of the challenges reported in this evaluation should be a threat to the continued success of the program.

Recommendations

Fullerton School District has successfully continued its Laptops for Learning program for a second year. The results of this evaluation highlight the varied use of the laptops for teaching and learning and the overall positive opinion of the program. However there were several challenges that should be addressed for continued success.

The first recommendation the evaluator has for Fullerton School District administration is based on parent survey questions and parent comments. It is strongly recommended that the school district make a greater effort to educate the parents about the program. First, parents at all schools expressed a strong desire to be more informed of how the laptop is being used at the school (Figure 7 and Table 21).

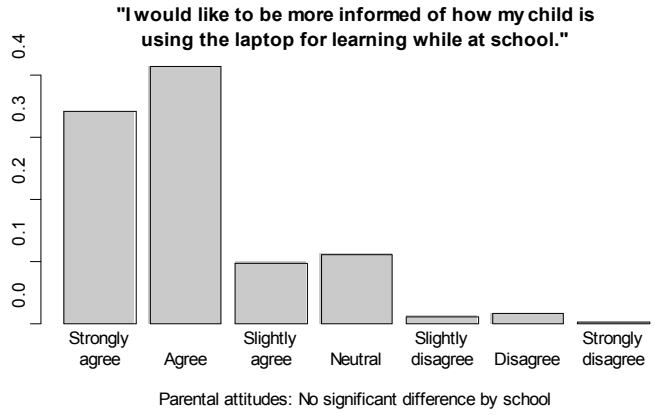

Figure 7: Parent responses to wanting to be more informed about program

Table 21: Parent responses to wanting to be more informed about program by school

School	Strongly Agree	Agree	Slightly Agree	Neutral	Slightly Disagree	Disagree	Strongly Disagree
Fisler	76	96	28	21	3	4	0
Nicolas	74	115	25	23	3	3	2
Golden Hill	21	11	1	5	0	2	0
Hermosa	33	25	5	18	2	1	0

Kruskal-Wallis chi-squared = 3.4699, df = 3, p-value = 0.3247

In addition to survey question data, there were several comments from parents that the evaluator perceived to be misconceptions (e.g., "I heard the Fullerton School district laid off employees to get 1:1 laptop program; I'm worried the students aren't learning cursive or how to use a dictionary"). With many parents financially backing this program, it is only fair that they be more informed and even be involved in decision-making. The evaluator considers there to be several ways to keep parents better informed of the program and to involve them more. First, parents could be more involved in the school tours that occur on a somewhat regular basis in the Laptops for Learning schools. Parents could either serve as tour guides and/or participate in the tour themselves. A second option would be to have a section in school newsletters or parent communication that specifically describes student use of the laptops for learning at school. As was commented by parents and students alike, student use of laptops for homework was not as consistent as it was in the classroom, so it is unfair of the district to expect parents to have insight into the program based on this.

A second recommendation based on parent involvement is related to their feeling a need for more control over the computers and questions about platform choice. As professional educators, Fullerton School District administrative personnel made informed decisions about choosing Macintosh computers and applications over other platforms and as a researcher the evaluator is cognizant of the rationale for such choices. However, in a society where Macintosh computers are more costly than other platforms and in the view of many, less prevalent, it is crucial for continued support that the district shares the background behind the decisions with the parents. It is human nature to want to be informed of decisions that impact ones own financial situation. One recommendation for

doing this is to add an FAQ section to the district website that includes this type of information and to supply such information to parents in written form as well. Perhaps at school PTO or PTA meetings the group could discuss suitable topics for an FAQ relative to being informed about the program decisions in addition to the program operation. A third recommendation related to involving parents, which would ultimately result in greater parent buy-in is to offer parent workshops. Figure 8 shows parent responses to the survey question asking them if they would attend trainings on educational applications.

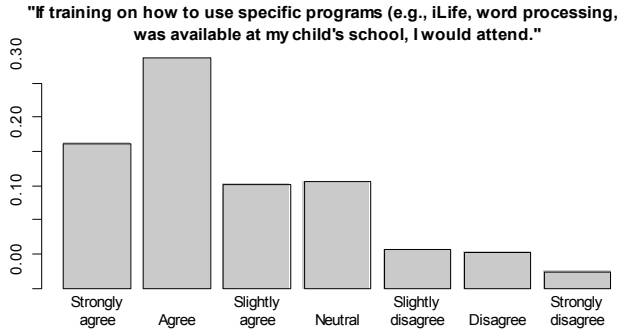

Figure 8: Parent responses to item regarding laptop training

Third, in addition to offering parent trainings on applications and laptop use, the evaluator feels it would be greatly beneficial to offer workshops on managing the child's home computer use. As professional educators, teachers received training on classroom management strategies that were necessary with the introduction of the laptops, yet parents who in many cases are cautious of the laptops themselves have received little advice on how to manage laptop use at home. Specifically, these trainings could discuss unsupervised student use of laptops (several students in grades as low as third had

Internet access in the bedroom and were allowed unsupervised on the Internet at any time), and strategies for discussing safe computer use (Internet safety and time restrictions). An undertone of despair was felt in parent comments about students using the laptops for MySpace and playing on the Internet instead of doing homework. These are very valid concerns but can be addressed by teaching the parents how to monitor laptop use and find a balance between using laptops for entertainment and other forms of entertainment in the home. Perhaps a parent handbook that offers strategies for addressing these challenges parents face would serve as a valuable tool.

A fourth recommendation for the Fullerton School district is based on student and parent comments on the surveys. As the Laptops for Learning program continues to strengthen and grow, the evaluator recommends the school district continue their efforts to use digital material in lieu of paper books. Many students and parents commented on the weight of the backpacks when students carried laptops in addition to heavy textbooks. There are increasing opportunities for using digital material as more textbook companies are offering material in digital format. One caution in this recommendation, however, is to not be reliant on web-based digital material as all students do not have ready access to the Internet in the home.

A fifth recommendation is based on the evaluation team's understanding that Fullerton School District is committed to giving all students in the Laptops for Learning program access to 21st century learning tools. Fullerton School District is in a powerful position to move one-to-one computing programs to the next level and that is to get greater community support. It is recommended by this evaluation team that Fullerton School District continue to pursue opportunities for obtaining home Internet access for all

students by petitioning sponsorship from cable and telephone companies to provide low-cost Internet access for educational purposes. Under the current circumstances in which some students have home Internet access and others don't, teachers are in a position that they cannot fairly assign Internet-based homework. If all students had home Internet access for educational purposes, there would be greater connection between home and school laptop use. This would also allow for greater web-based parent communication.

A final recommendation for the Fullerton School District is to continue monitoring the progress of the Laptops for Learning program but to reach beyond the current student, parent, and teacher population (many of whom expressed there have been too many surveys) and into the middle and high schools where former Laptops for Learning students are in attendance (e.g., Troy High School, Parks Junior High). Once again, due to the commitment of Fullerton School District to prepare students for a technology-rich society, it is recommended the school district move research in one-to-one computing forward while at the same time research the impact of their own program on student school success. With a greater influx of literature on one-to-one programs, it is less crucial to report on what is happening in Laptops for Learning classrooms and more important and relevant to examine long-term impacts of student involvement in a one-to-one computing initiative.

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About the Evaluation Team

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Douglas Grimes is a Doctoral Candidate at the University of California, Irvine (UCI) in the Department of Informatics. With his advisor, Mark Warschauer, Associate Professor of Education at UCI, he co-authored the first year evaluation for the Laptops for Learning program. Mr. Grimes spent fourteen years as a software and database developer and consultant and is currently conducting research on automated writing evaluation software.

Appendix

Statistical Analysis of FSD Score Changes in the California Standards Test

by Douglas Grimes

The following analysis is based on scaled scores of the ELA and math portions of the California Standards Test using matched cohorts (the same students in 2005 and 2006). This technique avoids variations due to changes in the student population. The first section of this appendix addresses junior high scores (students who were 7th and 8th graders in 2006 and 6th and 7th graders in 2005). The second section addresses scores of elementary students (grades three through six in 2006). The third second discusses the difference between the matched cohort technique and the more common unmatched technique. The fourth section summarizes conclusions. It is the least technical section and may be read without reading the others. The first section is the longest and most technical.

Five qualitative variables (factors) were considered:

1. Laptop status: Students were grouped by whether they attended one of the two 1:1 laptop schools, Nicolas and Fisler, or one of the other schools -- Ladera Vista, Parks, and Beechwood (7th grade only in 2006).
2. Schools: Students were grouped by their 2006 junior high school.
3. Language Fluency: Students were grouped by their 2006 language fluency classification.
4. Ethnicity: Students were grouped by their reported ethnicity in 2006.

5. Teacher: Students were grouped by their reported home room teacher

Three statistical techniques were employed. One-way analysis of variance (ANOVA) was used to ask if any of the groups or levels within a factor differed significantly from the overall mean. Two- and three-way ANOVAs were used to separate the main effects of two or three factors and to look for interaction effects between two factors. Pairwise comparison was used to identify significant differences in rates of progress among ethnic groups.

The terms "middle school" and "junior high school" are used interchangeably here to refer to seventh and eighth grades. The two K-8 schools, Beechwood and Fisler, have been split for this analysis, with seventh and eighth grades counted with middle schools, and lower grades counted with elementary schools.

I. Changes in Junior High School CST Scores

I. A. Changes in English Language Arts Scores

Scaled CST ELA scores improved an average of 5.9 points across the district. Although scores improved slightly more for students in Nicolas and Fisler than in the non 1:1 laptop schools, the difference between laptop and non-laptop schools was not statistically significant. Nor was there significant difference in improvement by school. There was a highly significant difference by language fluency[2], but language fluency

[2] As Table A1 shows, mean improvement for the 295 English Language Learners (ELLs) was over 12 points, almost twice as much as for English Only students and almost four times as much as I-FEP and R-FEP. If this pattern is sustained over multiple years, it would suggest that ELL students improve fast until their fluency is reclassified, at which time their rate of ELA improvement falls to about the same sub-average level as students who were classified as Initially Fluent English Proficiency (I-FEP). One possible explanation is that once they reach a minimal level of fluency, they lose motivation to continue improving their English skills.

explained less than 1% of the variation in scores. Figure A1 and Table A1 show the mean improvements in ELA scores by fluency group.

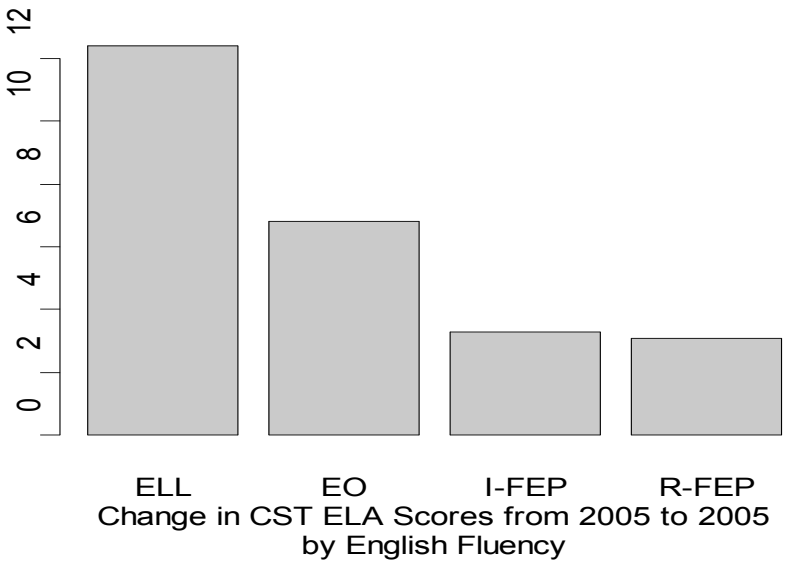

Figure A1 ↑

Table A1 Mean Change in CST ELA Scores from 2005 to 2006 by Language Fluency, FSD Junior High Students in 2006				
ELL (n = 295)	English Only (n = 1,268)	I-FEP (n = 443)	R-FEP (n = 666)	District (n = 2,689)
+12.9	+6.9	+3.4	+3.1	+6.0
SD of district mean: 30.0; coefficient of variation (district mean/SD): .20				

As can seen in Figure A2, mean differences among language fluency groups were small (coefficient of variation = .20), while variability within groups was large. The boxes in Figure A2 show inter-quartile ranges (25th to 75th percentile). The whiskers indicate 1.5 times the inter-quartile range. Outliers, represented by small circles beyond the whisker, indicate scores that rose or fell more than 1.5 times the inter-quartile range. These outliers were included in the analysis because they were consistent with a large-sample normal distribution.

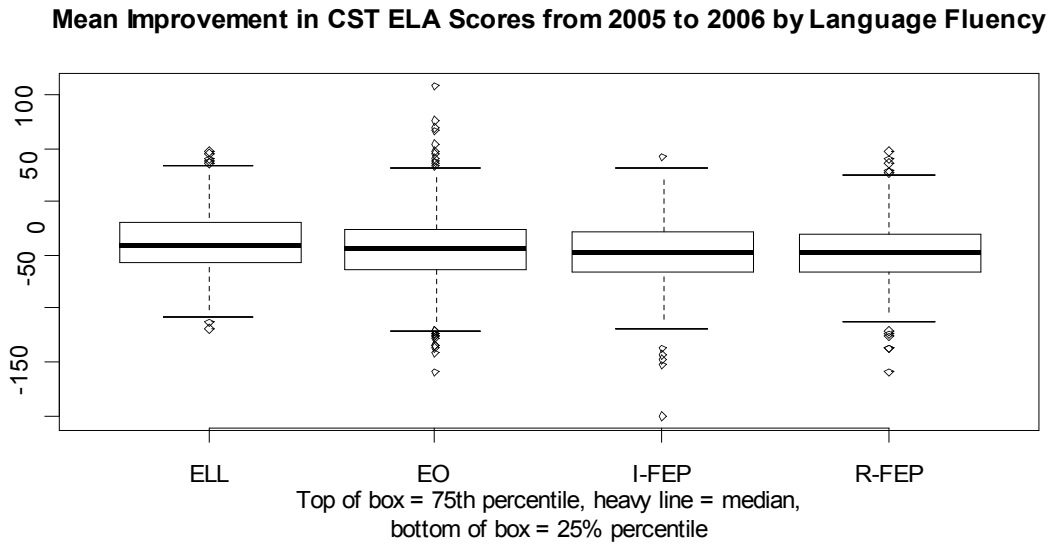

Figure A2 ↑

The rate of ELA score improvement for different language fluency categories varied by school and can be seen in Figure A3. Beechwood is not included because of the small number of students.

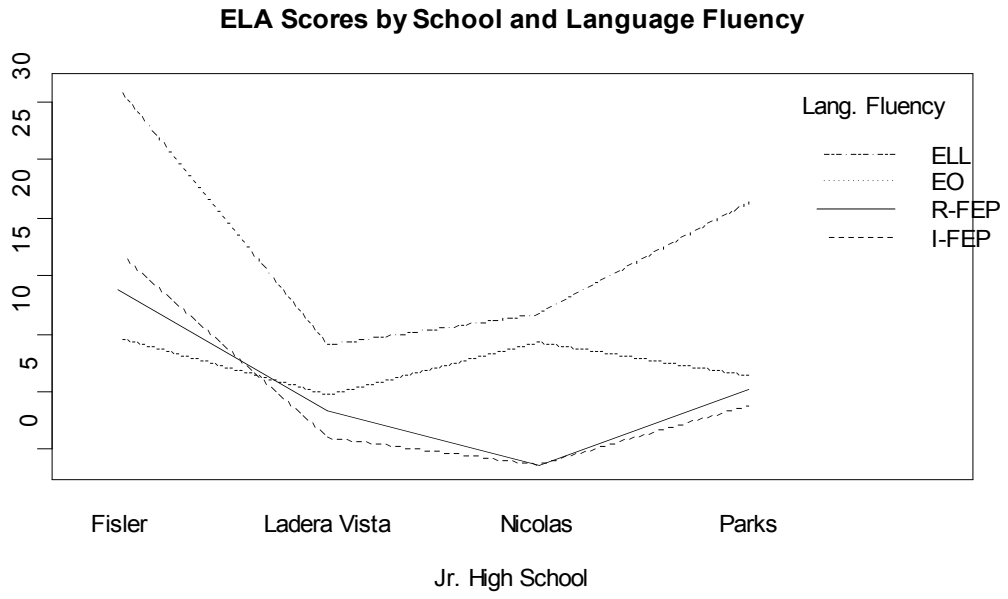

Figure A3 ↑

As can be seen in the graph, English Learners improved more than other language fluency groups at four schools shown here. Except at Parks, where ELs did well, all groups improved more at the K-8 schools, Beechwood (not shown) and Fisler, than at the three Junior High Schools. A two-way ANOVA for the four schools showed highly significant differences ($p < .001$) for language fluency and school, and a marginal interaction effect between school and language fluency ($p \sim .06$).[3] English Only students showed little variation by school; other language groups showed significant variation by school.

Changes in ELA scores were examined first for the nine ethnic groups with over 30 students, then for the four largest ethnic groups (African American, Asian, Hispanic, and White), with eight categories of Asian students grouped together (Asian Indian, Chinese, Japanese, Korean, Laotian, Vietnamese, and Other Asian). One-way ANOVAs of both ways of grouping students ethnically showed no significant difference between group means and overall mean ($p \sim .21$ for the nine ethnic groups with over 30 members; $p \sim .10$ for the four largest ethnic groups). This finding is in contrast with popular notions that some ethnic groups progress much faster than others. Figure A4 shows the similarity of means and distributions of the four largest ethnic groups. As before, the boxes indicate inter-quartile ranges and the whiskers extend 1.5 times beyond that range.

[3] Two-Way Analysis of Variance Table – Language Fluency and School:

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
langfl	3	24111	8037	9.0896	5.522e-06 ***
sch4	3	15203	5068	5.7314	0.000661 ***
langfl:sch4	9	14406	1601	1.8104	0.061557 .
Residuals	2619	2315696	884		

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

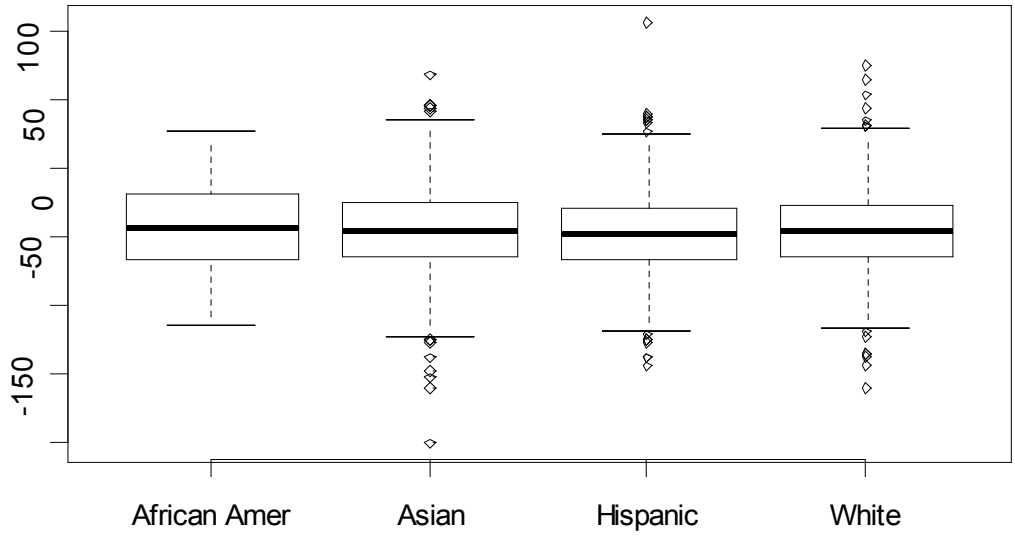

Figure A4 ↑

Figure A5 shows ELA changes for the four largest ethnic groups in each school except Beechwood. Whites (solid line) and Asians (dotted line) improved about the same amount, and more than Hispanics (alternate dots and dashes) in all four schools. Improvement by African Americans (dashed line) varied most among schools, but the number of African Americans is insufficient for strong inferences about their differential performance by school.

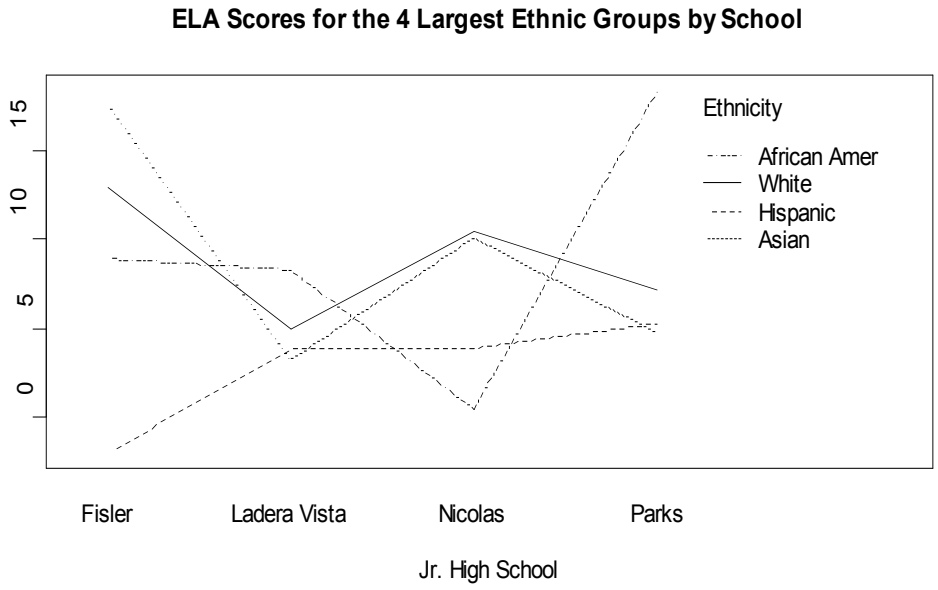

Figure A5 ↑

The preceding two figures of ELA changes for the four largest ethnic groups obscure the considerable differences among the seven subgroups which were lumped together as "Asian". Figure A6 sorts the nine ethnic groups with over 30 members by changes in ELA scores. It disaggregates the five largest Asian ethnicities and shows the wide range of scores among them. ELA scores of Asian Indians rose the least, while those of Vietnamese rose the most; Korean and Chinese were in the middle.

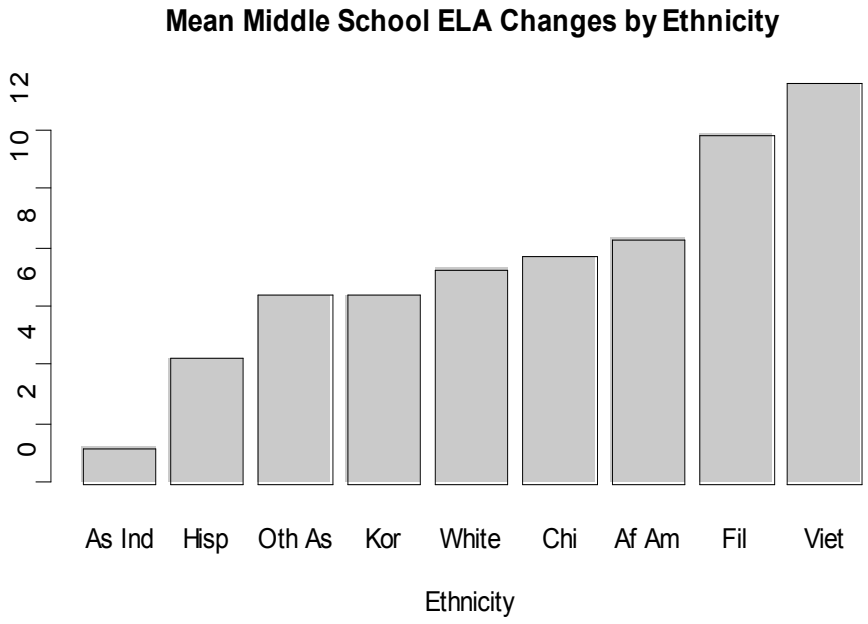

Figure A6 ↑

Inter-group differences in ELA scores were significant at the .05 level for three of the thirty-six pairs of ethnic groups (Table A2):

Table A2
Significant Differences in Mean ELA Score Changes by Ethnicity[4],
FSD Middle Schools, 2005 - 2006

Group 1	Group 2	Difference in Means, Group 1 - Group 2	p
Asian Indian	Vietnamese	-12.3	0.013
Hispanic	Vietnamese	-9.3	0.015
Hispanic	White	-3	0.013

Although the magnitude of mean difference between whites and Hispanics is small, the large numbers of students in those groups lead to small p values. The mean for African Americans improved by 1 point more than for whites, an insignificant difference statistically, but important in that it contradicts the argument that African Americans are an underserved minority at FSD.

[4] The complete table of 36 pairs of differences:

Differences in Mean ELA Score Changes by Ethnicity,
FSD Middle Schools, 2005 - 2006

Group 1	Group 2	Mean Diff	p	Group 1	Group 2	Mean Diff	p
Af Am	As Ind	7.1	0.88	Chi	Oth As	1.3	0.57
Af Am	Chi	0.6	0.53	Chi	Viet	-5.9	0.21
Af Am	Fil	-3.6	0.31	Chi	White	0.4	0.53
Af Am	Hisp	4.0	0.83	Fil	Hisp	7.6	0.94
Af Am	Kor	1.9	0.65	Fil	Kor	5.5	0.83
Af Am	Oth As	1.9	0.62	Fil	Oth As	5.5	0.79
Af Am	Viet	-5.3	0.20	Fil	Viet	-1.7	0.40
Af Am	White	1.0	0.59	Fil	White	4.6	0.82
As Ind	Chi	-6.4	0.18	Hisp	Kor	-2.1	0.10
As Ind	Fil	-10.6	0.05	Hisp	Oth As	-2.1	0.29
As Ind	Hisp	-3.0	0.26	Hisp	Viet	-9.3	0.01
As Ind	Kor	-5.2	0.17	Hisp	White	-3.0	0.01
As Ind	Oth As	-5.1	0.18	Kor	Oth As	0.0	0.50
As Ind	Viet	-12.3	0.01	Kor	Viet	-7.2	0.07
As Ind	White	-6.0	0.11	Kor	White	-0.9	0.31
Chi	Fil	-4.2	0.31	Oth As	Viet	-7.2	0.11
Chi	Hisp	3.4	0.77	Oth As	White	-0.9	0.41
Chi	Kor	1.3	0.60	Viet	White	6.3	0.92

None of the first four factors (laptop status, school, language fluency and ethnicity) explained as much as 1% of the variance in ELA score changes (R^2 column in Table A8). In contrast, homeroom teacher explained 5.3% of score changes, in spite of the fact that junior high students who share a homeroom teacher often do not share the same ELA teacher. It would be more meaningful to analyze ELA and math scores by ELA and math teachers, respectively, but the necessary class rosters were not available at the time of this writing.

There were no significant interaction effects between teacher and language fluency or ethnicity. The two-way ANOVA of the two most significant factors available, teacher and language fluency, explained 6.5% of the variation in ELA score changes.[5] Other two- and three-way ANOVAs were less powerful and showed no significant interaction effects (R^2 column Table A9). Taken together, these results indicate that roughly 90% of ELA variation was due to unaccounted factors or random variations.

I.B. Changes in Math Scores

CST math scores rose significantly for students in the 1:1 laptop schools and fell for students in the non-laptop schools (Table A3). This distinction was highly significant ($p < .001$):

Table A3
Mean Change in CST Math Scores from 2005 to 2006 by 1:1 Laptop Status
FSD Junior High Students in 2006

[5] Formula = teacher + language fluency
Analysis of Variance Table: Difference in ELA scores

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
teacher	66	128481	1947	2.244	5.91e-08 ***
lang fluency	3	28099	9366	10.796	4.76e-07 ***
Residuals	2602	2257452	868		

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Multiple R-Squared: 0.0649, Adjusted R-squared: 0.0401

1:1 Laptop Schools (n = 989)	Non 1:1 Laptop Schools (n = 1,683)	District (n = 2,672)
+4.8	-5.7	-1.8
SD of district mean: 42.5; coefficient of variation (district mean/SD): -.04		

At first glance this finding would appear to support the contention that the Laptops for Learning program enhances math skills. Such a conclusion is not warranted because mean score changes rose in Nicolas, while falling in Fisler. The mean increase for the much larger number of students at Nicolas outweighed the mean decrease at Fisler. Performance also varied among the non-1:1 schools: Mean math score changes rose in Ladera Vista, and fell sharply in Parks and Beechwood:

Table A4
Mean Change in CST Math Scores from 2005 to 2006 by School
FSD Junior High Students in 2006

Nicolas (n = 868)	Fisler (n =121)	Ladera Vista (n = 794)	Parks (n = 857)	Beechwood (n = 37)	District (N = 2,672)
+ 6.2	-4.9	3.6	-13.6	-20.9	-1.8

Although the variation by school is highly significant, it accounted for only 3% of variation in score changes (R^2 column in Table A8). Changes in math scores by language fluency (Table A5) and ethnicity (Table A6) were also highly significant, but explained less than 1% of variation in score changes.

Table A5
Mean Change in 7th & 8th Grade CST Math Scores
from 2005 to 2006 by Language Fluency

ELL (n = 295)	English Only (n = 1,268)	I-FEP (n = 443)	R-FEP (n = 666)	District (n = 2,672)
+8.6	-4.2	-5.3	+0.5	-1.8

Figure A7 is a graphical representation of the data in Table A6 – ethnic groups sorted by change in math scores.

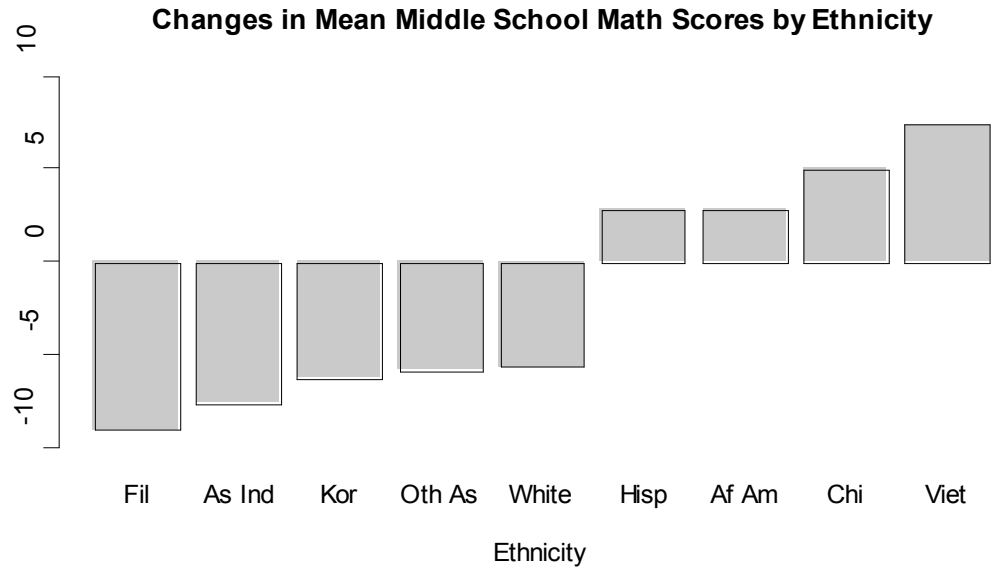

Figure A7 ↑

Table A6 (~ Figure A7)
Mean Change in 7th & 8th Grade CST Math Scores from 2005 to 2006 by Ethnicity
(Only ethnic groups with over 30 students are shown.)

	Filipino	Asian Indian	Korean	Other Asian	White	Hispanic	African Amer.	Chinese	Viet.
Change	-9.0	-7.6	-6.3	-5.8	-5.6	2.9	2.9	5.0	7.4
n	36	37	455	59	843	1054	49	42	47

Three pairs of ethnic groups had significant differences in mean math score changes (Table A7)[6]. The probability of having three of thirty-six pairs differ at the .05 level is less than .001. This is evidence that Hispanics, the lowest achieving group in math, are closing the gap with Filipinos, and that Vietnamese, a high achieving group, are gaining on Filipinos and Koreans in math.

[6] Note that the probability of a difference in mean scores depends on the difference in means and the number in each group, as well as the variance within each group (not shown).

Table A7
Significant Differences in Mean Math Score Changes by Ethnicity[7],
FSD Middle Schools, 2005 – 2006

Group 1	Group 2	Mean Difference, Group 1 - Group 2	p
Filipino	Hispanic	-11.9	0.032
Filipino	Vietnamese	-16.4	0.028
Korean	Vietnamese	-13.6	0.036

As with any normally distributed data, mean changes should not be taken as predetermining any single student's progress. As in the case of ELA scores (Figure A2), math scores for a number of students either improved or fell by more than 100 points (Figure A8).

[7] The complete table of 36 pairs of differences:

Differences in Mean Math Score Changes by Ethnicity,
FSD Middle Schools, 2005 - 2006

Group 1	Group 2	Mean Diff	p	Group 1	Group 2	Mean Diff	p
Af Am	As Ind	10.5	0.87	Chi	Oth As	10.9	0.82
Af Am	Chi	-2.1	0.43	Chi	Viet	-2.4	0.42
Af Am	Fil	11.9	0.92	Chi	White	10.7	0.94
Af Am	Hisp	0.0	0.50	Fil	Hisp	-11.9	0.03*
Af Am	Kor	9.1	0.89	Fil	Kor	-2.8	0.37
Af Am	Oth As	8.7	0.85	Fil	Oth As	-3.2	0.37
Af Am	Viet	-4.5	0.26	Fil	Viet	-16.4	0.03*
Af Am	White	8.5	0.92	Fil	White	-3.4	0.32
As Ind	Chi	-12.6	0.18	Hisp	Kor	9.1	1.00
As Ind	Fil	1.4	0.55	Hisp	Oth As	8.7	0.96
As Ind	Hisp	-10.5	0.05	Hisp	Viet	-4.5	0.21
As Ind	Kor	-1.4	0.44	Hisp	White	8.5	1.00
As Ind	Oth As	-1.8	0.43	Kor	Oth As	-0.4	0.48
As Ind	Viet	-15.0	0.05	Kor	Viet	-13.6	0.04*
As Ind	White	-2.0	0.39	Kor	White	-0.6	0.41
Chi	Fil	14.1	0.85	Oth As	Viet	-13.2	0.06
Chi	Hisp	2.2	0.64	Oth As	White	-0.2	0.49
Chi	Kor	11.3	0.91	Viet	White	13.0	0.98

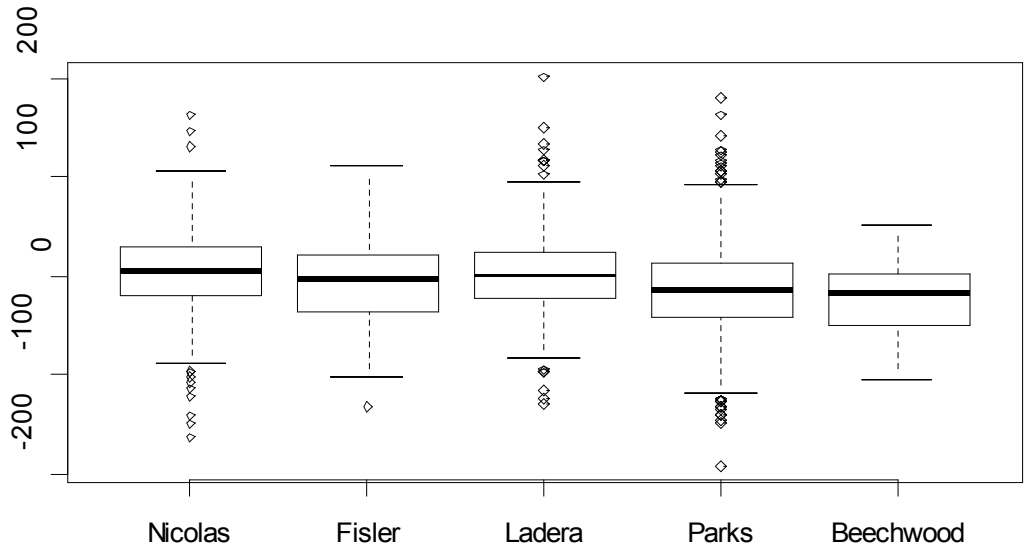

Figure A8 ↑

None of the first four factors (laptops, school, language fluency, or ethnicity) explained more than 3% of the variation in math score changes; in contrast, homeroom teacher explained over 8.2% of the variation (Table A8). As with ELA scores, the fact that homeroom teacher is far more highly correlated with learning outcomes than the other factors is surprising because students with the same homeroom teacher often have different math teachers. It appears that there is a positive correlation between homeroom teachers and both ELA and math teachers.

I. C. Summary of Junior High School Test Score Analysis

The year-to-year differences in district CST scores were +5.9 for ELA and -1.8 for math. The variance in math scores was twice as high as in ELA scores.[8]

[8] Variance was 1808 for math and 905 for ELA score changes.

All five factors (school, laptop use, language fluency, ethnicity, and teacher) were significantly correlated with changes in both ELA and math scores, but they explained relatively little of the variation in score changes (Table A8). Although homeroom teacher showed the highest correlation with changes in scores, it explained only about 5% of score variations for ELA and about 11% for math. The lack of student rosters for ELA and math teachers limited the value of middle schools analysis by teacher.

Table A8
Summary of One-Way Analyses of Variance, 7th & 8th Grades[9]

Test	Factor(s)	Probability (p)	R^2	Adjusted R^2
ELA	Laptop status	0.2759	0.0004396	0.00006943
	School	0.921	0.000004	0.0003667
	Lang. Fluency	2.348e-05	0.008964	0.007855
	Ethnicity	0.1844	0.004302	0.001264
	Teacher	1.146e-07	0.05289	0.0288
Math	Laptop status	6.099e-10	0.01415	0.01378
	School	< 2.2e-16	0.03014	0.02978
	Lang. Fluency	6.32e-06	0.01001	0.008899
	Ethnicity	0.000167	0.01162	0.008595
	Teacher	< 2.2e-16	0.08122	0.05773

N = 2702, matched cohort design
R^2 indicates the amount of total variation in score changes explained by the model (1.0 = 100%). Adjusted R^2 takes into consideration the model's complexity, and is preferred for comparing models.

[9] A number of two- and three-factor models were also tested. This three-factor model shows a three-way interaction effect of teacher, language fluency, and ethnicity. However, unless there is strong theoretical justification for including the interaction effect, many statisticians would favor a more parsimonious model without it:

Analysis of Variance Table
Model: Change in math score ~ teacher + langfl + ethnicity + teacher:langfl:ethnicity

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
teacher	66	401600	6085	3.6708	< 2.2e-16 ***
langfl	3	26778	8926	5.3848	0.001083 **
ethnicity	8	30173	3772	2.2753	0.020123 *
tea:langfl:eth	400	758124	1895	1.1434	0.037267 *
Residuals	2144	3553984	1658		

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

The low R^2 values for both one-way and two-way ANOVAs contradict popular notions that technology (laptops in this case), school, ethnicity, and language fluency are strong determinants of students' progress, but they leave room for a strong influence of teachers in students' ELA development.

II. Changes in Elementary School CST Scores

CST scores for grades 3 through 6 increased by an average of 5.5 points in ELA and 4.2 points in math. School explained approximately 1% of the change in ELA and math; language fluency and ethnicity explained much less. Teacher, however, explained 24% of the change in ELA, 21% of the change in math, and 24% of the combined ELA and math scores (Table A9):

Table A9
Summary of One-Way ANOVAs – 3rd - 6th Grades

Test	Factor(s)	Probability (p)	R^2	Adjusted R^2
ELA	School	3.1e-09	0.013	0.010
	Lang. Fluency	0.02	0.0018	0.0013
	Ethnicity	0.53	0.0014	0.00018
	Teacher	2.2e-16	0.24	0.20
Math	School	1.5e-10	0.015	0.012
	Lang. Fluency	0.0053	0.0024	0.0018
	Ethnicity	0.029	0.0033	0.0018
	Teacher	2.2e-16	0.21	0.17
ELA + Math	Teacher	< 2e-16	0.24	0.207

The fact that teacher had more explanatory power in the elementary than junior high grades must be due to the fact that most elementary students have the same teacher all day, so the homeroom teacher also serves as both ELA and math teacher. Results for school, ethnicity, and language fluency in the elementary grades are very similar to those

in junior high grades in that they have negligible explanatory power on the variation in score changes (low R^2 values). Figure A9, the only display in this appendix with absolute scores, shows mean combined ELA plus math scores for grades three through six in 2006.

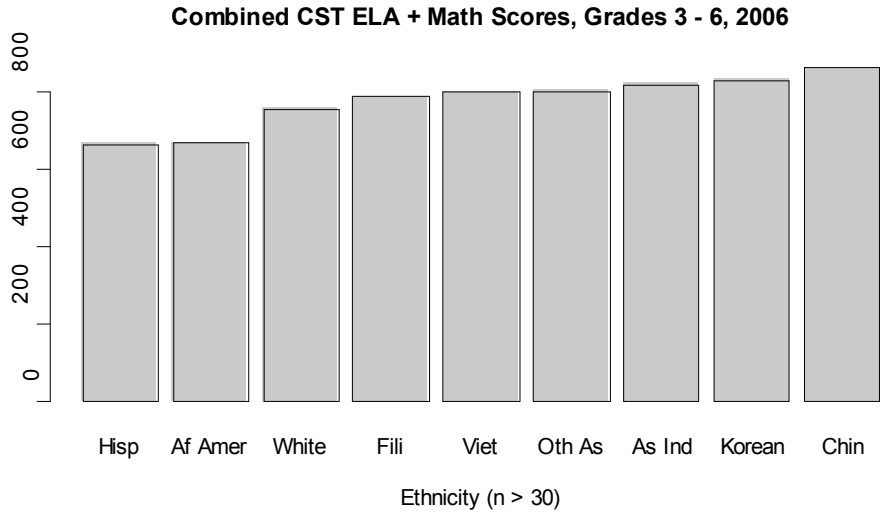

Figure A9 ↑

Although ethnicity explains only about 1% of variation in ELA and math score changes at the junior high level, and much less than 1% in elementary school, it is a powerful predictor of absolute differences in mean scores. In elementary schools for example, for the nine ethnic groups with over 30 members, ethnicity explains over 20% of variation in absolute scores (in 2006 R^2 = 22% for ELA and 20% for math).

As in the junior high schools, there were no significant differences in changes in ELA scores by ethnicity in grades three through six, but there were significant differences by ethnicity for changes in math scores (Table A9). Tables A10 and A11 and the corresponding bar charts, Figures A10 and A11, show the sorted mean changes in scores

for the nine ethnic groups. Only one of the thirty-six pairs of groups was significantly different at the .05 level for ELA (Table A12), a significant result for the two groups involved (Koreans improved relative to Hispanics), but an insignificant one in terms of all thirty-six pairs ($p \sim .30$).

Differential rates of progress in elementary school were more pronounced for math; four of the thirty-six pairs of ethnic groups differed at the .05 level (Table A13. $p \sim .00004$ for four of thirty-six pairs). However, the ELA and math rankings differ substantially, especially for Asian Indians, who ranked lowest in ELA and highest in math in terms of change in scores.

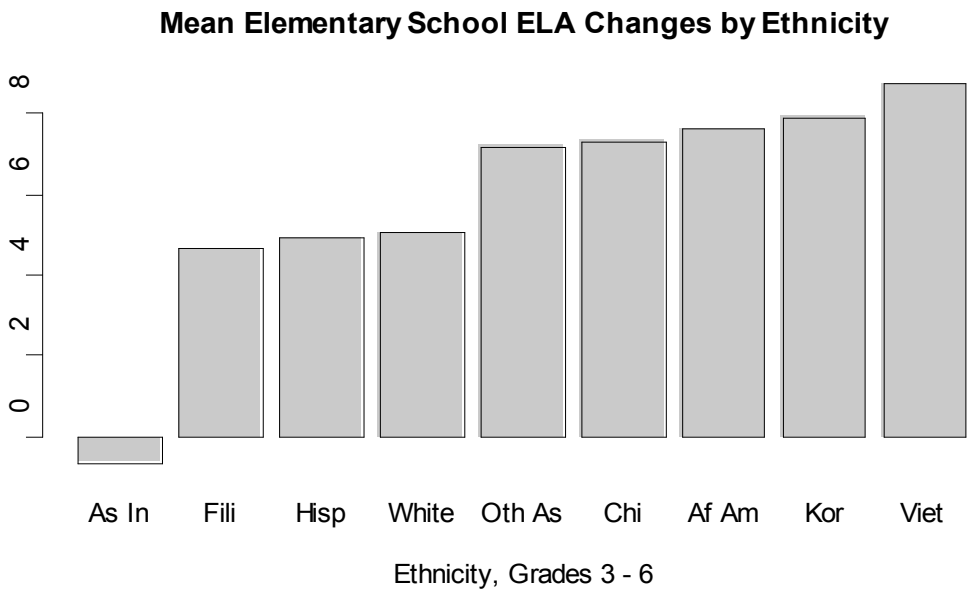

Figure A10↑

Table A10 (~ Figure A9)
Sorted Mean Change in 3rd - 6th Grade ELA Scores from 2005 to 2006 by Ethnicity
(Only ethnic groups with over 30 students are shown.)

	Asian Indian	Fili	Hisp	White	Other Asian	Chinese	African Amer	Korean	Viet
mean	-0.6	4.7	4.9	5.1	7.2	7.4	7.6	7.9	8.8
n	49	73	2457	1584	103	89	90	664	92

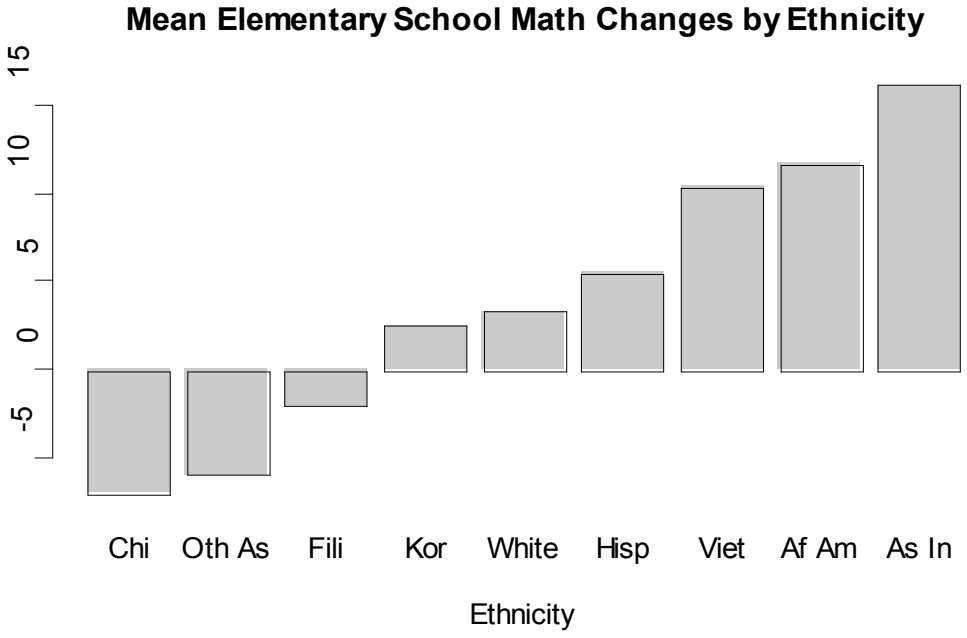

Figure A11↑

Table A11 (~ Figure A11)
Sorted Mean Change in 3rd - 6th Grade Math Scores from 2005 to 2006 by Ethnicity
(Only ethnic groups with over 30 students are shown.)

	Chi	Other Asian	Fili	Korean	White	Hisp	Viet	African Amer	Asian Indian
mean	-6.9	-5.9	-2	2.5	3.4	5.5	10.3	11.6	16.1
n	89	103	73	664	1584	2457	92	90	49

Table A12
Significant Differences in Mean ELA Score Changes by Ethnicity[10],
FSD Grades 3-6, 2005 – 2006

Group 1	Group 2	Mean Difference, Group 1 - Group 2	p
Hisp	Kor	-3	0.03

[10] The complete set of 36 pairs of ethnic groups and difference in their mean ELA score changes:

Differences in Mean ELA Score Changes by Ethnicity,
FSD Elementary Schools, Grades 3 – 6, 2005 – 2006 School Years

Group 1	Group 2	Mean Diff	p	Group 1	Group 2	Mean Diff	p
Af Am	As In	8.3	0.91	Chi	Oth As	0.1	0.51
Af Am	Chi	0.3	0.52	Chi	Viet	-1.4	0.40
Af Am	Fili	2.9	0.71	Chi	White	2.3	0.72
Af Am	Hisp	2.7	0.77	Fili	Hisp	-0.2	0.48
Af Am	Kor	-0.3	0.47	Fili	Kor	-3.3	0.24
Af Am	Oth As	0.4	0.53	Fili	Oth As	-2.5	0.32
Af Am	Viet	-1.1	0.41	Fili	Viet	-4.1	0.21
Af Am	White	2.6	0.74	Fili	White	-0.4	0.46
As In	Chi	-8	0.13	Hisp	Kor	-3	0.03
As In	Fili	-5.3	0.21	Hisp	Oth As	-2.3	0.25
As In	Hisp	-5.6	0.13	Hisp	Viet	-3.8	0.15
As In	Kor	-8.6	0.07	Hisp	White	-0.1	0.45
As In	Oth As	-7.9	0.11	Kor	Oth As	0.7	0.57
As In	Viet	-9.4	0.06	Kor	Viet	-0.8	0.42
As In	White	-5.7	0.14	Kor	White	2.9	0.95
Chi	Fili	2.7	0.68	Oth As	Viet	-1.5	0.38
Chi	Hisp	2.4	0.74	Oth As	White	2.1	0.72
Chi	Kor	-0.6	0.45	Viet	White	3.7	0.83

Table A13
Significant Differences in Mean Math Score Changes by Ethnicity[11],
FSD Grades 3-6, 2005 – 2006

Group 1	Group 2	Mean Difference, Group 1 - Group 2	p
Chi	Hisp	-12.4	0.01
Chi	Viet	-17.3	0.02
Chi	White	-10.3	0.04
Oth As	Viet	-16.2	0.04

In order to compare the potential effect of teachers with the effects of other factors, all possible two- and three-way ANOVAs were run for school, language fluency, and ethnicity for both ELA and math scores. None of the models showed significant interaction effects (i.e., these three factors are not significantly interrelated in their

[11] Differences in mean score changes and probabilities for the complete set of 36 pairs of ethnicities:

Differences in Mean Math Score Changes by Ethnicity,
FSD Elementary Schools, Grades 3 – 6, 2005 – 2006

Group 1	Group 2	Mean Diff	p	Group 1	Group 2	Mean Diff	p
Af Am	As In	-4.5	0.31	Chi	Oth As	-1.1	0.45
Af Am	Chi	18.6	0.99	Chi	Viet	-17.3	0.02
Af Am	Fili	13.6	0.97	Chi	White	-10.3	0.04
Af Am	Hisp	6.1	0.89	Fili	Hisp	-7.5	0.09
Af Am	Kor	9.1	0.92	Fili	Kor	-4.5	0.27
Af Am	Oth As	17.5	0.98	Fili	Oth As	3.9	0.66
Af Am	Viet	1.3	0.57	Fili	Viet	-12.3	0.07
Af Am	White	8.2	0.92	Fili	White	-5.4	0.21
As In	Chi	23.1	0.99	Hisp	Kor	3	0.91
As In	Fili	18.1	0.97	Hisp	Oth As	11.4	0.99
As In	Hisp	10.6	0.94	Hisp	Viet	-4.9	0.17
As In	Kor	13.6	0.94	Hisp	White	2.1	0.90
As In	Oth As	22	0.97	Kor	Oth As	8.4	0.90
As In	Viet	5.8	0.72	Kor	Viet	-7.8	0.12
As In	White	12.7	0.95	Kor	White	-0.9	0.37
Chi	Fili	-5	0.28	Oth As	Viet	-16.2	0.04
Chi	Hisp	-12.4	0.01	Oth As	White	-9.2	0.05
Chi	Kor	-9.5	0.08	Viet	White	7	0.88

effects), so the models with interaction effects were dropped. The three factors together accounted for less than 2% of variation in both ELA and math score changes (Table A13). In comparison, homeroom teacher alone accounted for 5.3% of ELA and 8.1% of math score changes (Table A8). Hence, the simple models of teacher alone are more powerful than models using any combination of the other factors. This evidence is consistent with the argument that the quality of teachers is more important to learning than ethnicity, language fluency, and school combined.

Table A14
Summary of Three-Way ANOVAs – 3rd - 6th Grades

Test	Factor(s)[12]	Probability (p)	R^2	Adjusted R^2
ELA	School + Lang. Fluency + Ethnicity	3.3e-10	0.019	0.014
Math	School + Lang. Fluency + Ethnicity	4.1e-11	0.020	0.015
ELA + Math	School + Ethnicity	1.1e-14	0.022	0.018

Since the No Child Left Behind Act (NCLB) places great emphasis on school and ethnicity, it seemed fitting to combine ELA plus math changes in a single model with school and ethnicity (the last line in Table A14). As in the other elementary school models, there were no significant interaction effects between school and ethnicity[13],

[12] "+" indicates factors were taken individually. "*" indicates factors were taken in all possible combinations. Thus, "A*B" means A was added, then B, then the interaction of A and B.

[13] Analysis of Variance Table
Formula: Combined ELA and math differences ~ ethnicity * school

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
eth	23	150911	6561	1.326	0.136	
sch	15	544789	36319	7.340	2.42e-16	***
eth:sch	155	863962	5574	1.127	0.138	
Residuals	5146	25461791	4948			

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

lending more support to preceding evidence that FSD schools do not treat any particular ethnic groups prejudicially or preferentially. The model of school plus ethnicity without interaction effects explained only 2.2% of the variation in combined ELA plus math scores, less than one-tenth of the 24% explained by teacher alone (Table A8). Again, teachers remain by far the most powerful factor tested in explaining why some students progress faster than others.

III. Comparison of Matched and Unmatched Approaches

Given the importance of the CST and other standardized tests for educators, legislators, parents, and students, let us compare Fullerton's elementary school rankings using matched and unmatched techniques. As can be seen in Table A15, changing the ranking technique between matched and unmatched can change a school's rank in district standings by as much as 4 out of 16 places:

Table A15
Elementary School Rankings: Matched vs. Unmatched Cohorts
Changes in Combined ELA + Math Scores, Grades 3-6 in 2006

School	Unmatched Rank	Matched Rank	Change
Acacia	14	15	1
Beechwood Elem.	12	13	1
Commonwealth	3	3	0
Fern Hill	11	11	0
Golden Hill	1	2	1
Hermosa Dr.	15	12	-3
Laguna Rd.	9	8	-1
Maple	4	4	0
Orangethorpe	10	9	-1
Pacific Dr.	5	5	0
Raymond	8	7	-1
Richman	13	14	1
Rolling Hills	7	6	-1

Sunset Lane	6	10	4
Woodcrest	2	1	-1
Fisler Elem.	16	16	0

N = 5,353 students for unmatched, 6,185 for matched.

Unlike the official scores, (a) these rankings are based on ELA and Math scores only, and omit science and social science scores; and (b) 2nd grade is omitted, except as a baseline for students who were in 3rd grade in 2006. Ranks are based on average change in scores between years, not average scores in a single year. Schools that are ranked high in terms of average scores tend to be ranked low in terms of year-to-year change in scores.

Given the overall enthusiasm for the Laptops for Learning program among teachers, students, and parents at Fisler, it is surprising that combined ELA plus math scores at Fisler fell further than at any other school. The paradox is resolved by noting, first, that Fisler's 7 point overall decline was not statistically significant ($p \sim .63$). Second, Fisler ELA scores actually rose an average of 1 point, but their math scores fell approximately 8 points, and laptops are generally used little in math classes. In contrast to the non-significant change in scores at Fisler, the gains for Commonwealth, Golden Hill, Pacific Drive, and Woodcrest were all significant at the .001 level.

IV. Conclusions

As statistics teachers are wont to say, correlation does not imply causality, so we cannot conclude from the preceding evidence that any of the five factors considered here affected CST scores or the skills they purport to measure. However, lack of correlation may help to undermine claims of causal effects, while strong correlation leaves the door open for causal arguments. Thus we can we can draw several conclusions from the preceding results:

1. The low R^2 values for laptop status, school, ethnicity, and language fluency suggest that these factors have at most very small effects (approximately 1 - 3%) on rates of learning as measured by the CST exam. Of the five factors considered here, only teachers are likely to affect students' progress to an important degree, perhaps 20% to 24% on the average. These findings challenge common beliefs that school, ethnicity, language fluency, and technology are strong determinants of learning progress.

2. Although ethnicity accounts for only about 1% of variation in score changes among students, the differences are sufficiently large to contribute to large disparities in progress among ethnic groups if sustained throughout a students' career in FSD. Disparities in rates of growth among ethnic groups are highly nuanced and defy common stereotypes. For ELA scores in both junior high and elementary schools, the similarities in rates of learning for diverse ethnic groups were more noteworthy than the differences. In contrast, rates of learning in math differed significantly among ethnic groups at both the junior high and elementary levels.

3. CST scores provide no evidence that the Laptops for Learning program enhanced either ELA or math skills. This does not indicate a lack of enhanced learning with laptops because the CST appears to measure different skills than those developed by the Laptops for Learning program.

4. The low explanatory power of school, ethnicity, and language fluency, and the modest number of statistically significant differences between pairs of groups also challenge the justification for NCLB, which penalizes schools for failing to show adequate year-to-year improvement in test scores, either for the entire school, or for significant ethnic groups within a school. It is this researcher's opinion that for federal or

state authorities to justify their intervention in school management, they should at least be able to demonstrate more substantial disparities among schools and ethnic groups. The correlations reported here are too low to justify the enormous resources devoted to test preparation and administration and avoidance of NCLB sanctions. The same resources would be better spent on teacher development and retention.

A major limitation of this research is that it is limited to a single year in a single school district. It is possible that a study of multiple districts would reveal significant variation among districts, either overall, or in combination with other factors, especially ethnicity. A longitudinal study of students as they progress from second grade to eighth would further illuminate the different rates of progress by ethnicity, school, and technology exposure. Small differences in annual progress might cumulatively amount to large differences in students' K-8 learning outcomes and their subsequent academic and professional careers.