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Final Report on Saugus Union School District's SWATTEC Program

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Introduction

The Saugus Union School District is currently carrying out an education reform program known as SWATTEC: Student Writing Achievement Through Technology Enhanced Collaboration. As part of this initiative, since January 2009, all fourth grade students in the district have been provided a low-cost Asus Eee PC netbook computer, together with an open source Linux-based operating system, a wide array of other open source software, access to free cloud-based or online resources, and a subscription to a commercial online writing and essay scoring program called MY Access!

We have conducted a study of this SUSD program as part of a national research project investigating laptops in education, and specifically the educational use of low-cost netbooks and open source software. The project investigated (1) the impact of the program on teaching and learning processes, (2) the impact of the program on learning outcomes in writing and English language arts, (3) the particular impact of the program on diverse learners, and (4) the perceived match of netbook and open source software with the needs of teachers and students and their suitability in educational improvement efforts.

Research Methods

Surveys and standardized rest results were collected and analyzed district wide. Interviews were conducted with district personnel and with teachers attending district-wide workshops. In addition, two SUSD schools, North Park and Skyblue Mesa, were selected as focal schools for additional interviews and classroom observations following consultation with district personnel regarding sites that would best reflect the program's impact on diverse students. Between the two schools, there are students from a range of socioeconomic backgrounds. In addition, Skyblue Mesa has a large number of English language learners and North Park has a special day class involved in the SWATTEC program.

Research in Saugus centered around day-long visits to the district about twice a month between November 2009 and June 2010. The following data were collected for the study:

Test Scores. English Language Arts California Standards Test scores were collected for third and fourth grade students from 2007 to 2010. Scores from the district writing test that was administered at the beginning and end of the 2009-2010 school year were collected for all fourth grade students.

Online Teacher and Student Surveys. Online surveys developed for teachers and students in the SWATTEC program were given out in spring 2010. Teacher surveys asked 31 questions on topics such as self-perceived computer skills, ability to integrate technology in instruction, frequency of student laptop use for particular tasks and activities, how teaching with laptops compares to teaching without them, advantages and disadvantages of using laptops for teaching and learning, the effect of the program on particular subjects and particular subsets of students, and the overall evaluation of the laptop program. Student surveys asked 21 questions focusing on computer and Internet access at home, self-reported grades, amount of computer use at school and home for particular purposes and subjects, frequency of using laptops for particular subjects, how their study habits or attitudes have changed since they received the laptops, and their opinions of the best and worst aspects of the laptop program.

Observations. Six days of classroom observations were carried out at each of the two focal schools for several hours each day. During these days, researchers were given cart blanche to wander between the fourth grade classrooms at the schools and observe instruction. The research team was also allowed to roam within the classroom, peer over shoulders to observe the students' work, and engage in non-disruptive informal discussion with students or teachers to better understand classroom activities. Field notes were taken during and after the observations with a focus on documenting how the laptops were being used, and if and how such use appeared to be contributing to student learning.

Interviews. Individual or group interviews were conducted with the school principals and with fourth grade teachers at the two focal schools and with a small group of students at each site. The students were selected by teachers to represent a diverse group of pupils in their classes. Interviews with both teachers and students focused on how the laptops were used in instruction and participants' opinions about the laptop program. In addition, two group interviews were also held with a total of 20 teachers from five other schools that were having professional development sessions at the district office, and interviews were also held with the Assistant Superintendent of Instruction & Curriculum, the Director of Information Services and Technology, and with a District Intervention Specialist with specialization in writing instruction.

Documents. A number of publicly available documents have been collected and reviewed, including district reports on the SWATTEC program, online materials developed by teachers, and educational blog postings by students and teachers.

Test scores and survey results have been analyzed using standard quantitative procedures to determine descriptive frequencies, t-test analyses, and regression analyses. All interviews were digitally recorded and transcribed, and observations, interviews, and documents have been coded and analyzed with the assistance of qualitative data analysis software.

In addition, the research team has carried out similar case studies of laptops and learning in 11 other school districts across the country located in Maine, Alabama, Colorado, and California. A comparison of Saugus data to this broader data set has been used to understand how educational use of laptops in Saugus corresponds with effective educational technology practices elsewhere.

Findings

Overall, the Saugus laptop program appears to be very well designed, thoughtfully implemented, and well received by teachers and students. Learning activities with laptops match well with what is known about how students learn best with technology. Netbooks are used extensively in instruction, especially for teaching writing and among English language learners. Both teachers and students have very positive attitudes to the program, and the program has had a significant positive effect on student writing achievement. We delineate these findings in two general areas: teaching and learning processes, and learning outcomes.

Teaching and Learning Processes

(1) Teaching and Learning of Writing

Research suggests that a focus on expository writing is invaluable both for improving students' education and for preparing students to participate in a knowledge economy. As the SUSD Assistant District Superintendent for Curriculum & Instruction explained in an interview,

> Writing is one of the higher thinking skills. If a child can write about what they learned that means they had to synthesize it, summarize it, and have some kind of opinion about it. Where as you can give a paper pencil exam with a bubble on it with pick a number or a letter. It's not about what they know; it's about what they don't know. We are finding that writing helps kids put their thoughts onto paper. I think it also gives us a lot of information about where some of those wholes are.

Surveys, interviews, and observations suggest that netbooks are used extensively in classrooms, and the most frequent use of laptops in classrooms is in writing or editing papers. Students spend about two hours per day using their laptops. Teachers and students indicate that the quantity and quality of student writing has increased with laptops. In surveys, students report that when using their laptops, they tend to write more, revise more, and get more feedback on their writing. Some 60% of them believe that the quality of their writing improved since use of laptops and some 70% of students prefer typing on their computers instead of writing using pencil and paper.

Early in the year, there was great enthusiasm among teachers for the MY Access program and tools, but this seemed to moderate over the course of the year and varied greatly from school to school and teacher to teacher. Our survey and test score analysis found outcome benefits from access to and use of the netbooks, but we were not able to distinguish any differential benefits from how much or how little particular applications, such as MY Access, were used.

(2) Differentiated Instruction

With a state budget that makes decrease of class size difficult, and with many California classrooms bringing together diverse student populations, including English language learners, students with literacy challenges, and gifted and talented students, all in the same classroom, it is difficult for a teacher to meet individual students needs. Another major strength of the laptop program in Saugus lies in student individualization, allowing teachers, whether it be in Science, Math, English Language Arts, or Social Studies, to direct students to online readings, exercises, projects, games, or quizzes that are tightly aligned with their individual needs.

In math, for example, we observed teachers point students to free online resources so that they could practice the exact skills they need to improve. In social studies, we saw students working at their own level and pace in doing research on California missions. In language arts, we observed students taking online quizzes on their own independent reading or on individually designed sets of spelling words. In science, students are able to access streaming videos at their own pace. All these things appear to lead to a more productive use of class time.

We also learned that the laptop program is a good match for the district's diverse students. For example, we saw how students in the Gifted and Talented Education Program had access to online resources to carry out substantive research projects in class. We also heard from a special education teacher who commented that the laptops have been especially valuable for her students, as it provides them a means to scaffold their abilities and thus participate more equally with other students in the school. She explained that "using the laptops has greatly increased the confidence of my students."

When examining laptop use among different groups of students, it was found that English language learners use laptops more than other groups at school. Teachers we interviewed at several sites spoke to the particular advantages of laptop use for English learners, including the effectiveness of laptops in offering multimodal input to English language learners and in giving learners opportunities to catch up in communication and language skills through computer-mediated writing and interaction. Teachers also told us that use of laptops was especially motivating to English language learners.

(3) Making Connections for Deeper Learning

U.S. education, even in the best schools, has been sometimes criticized for being a "mile wide and an inch deep." In pursuit of a long and growing list of individual standards, teachers and students often lack the time and resources to carry out the kind of in-depth investigation that enriches learning.

Interviews and observations suggested that the laptop program is facilitating this kind of deeper learning by readily providing resources beyond those typically involved in a classroom. One teacher explained, for example, how she set up a Skype conversation with a relative serving in Iraq to give students more of a firsthand view of the conflict there. Students followed up by writing about the topic in their blogs. Other teachers explained how the textbook only covers certain ecosystems, so they have their students go online and conduct research on additional

ecosystems. And rather than just reading about data analysis and graphs, students use spreadsheets to chart and analyze environmental data. Students also use laptops for research projects. In the process of looking up information for assignments, they have learned about how to find, analyze, evaluate, and make use of online information, all valuable skills for today's world.

Similar to what has been found in laptop programs elsewhere, Saugus students report that they find these activities highly engaging, and teachers also report that they are energized to teach in laptop classrooms. Most importantly, though, this engagement and energy appear to be tied to the pursuit of substantive learning objectives.

(4) Sustainable Implementation

Although others have found similarly positive results in laptop programs with larger and more expensive computers and more commercial software, it is often difficult to sustain these more costly initiatives. We thus entered this study with a real curiosity as to possible effectiveness of a laptop program using small, low-cost netbooks, an open source operating system, and, for the most part, free open source software.

Surveys, interviews, and observations suggest that Saugus has chosen the right tools for the job. The netbooks and software are performing quite well and teachers report few technical problems, most of which are quickly and easily solved. The small form factor of the netbooks appears to be an advantage; the machines are very light and take up comparatively little room on student desks. The open software seems to be the most cost-effective option; the social networking tools created by the district allow both teachers and students the chance to collaborate online through blogs and wikis, and the wide range of free software used allows the same kind of learning activities that we have observed in laptop programs elsewhere. The survey revealed that almost all teachers hope the program continues at their schools, and that they also would recommend the program to others.

We also note that the Information Services and Technology Department and its Director have generously made the resources that they have developed, such as the customized open source software suite, available to other districts. Other districts where we have been conducting research have made use of these tools very successfully, and are very appreciate of SUSD's leadership in this area.

Learning Outcomes

Our analysis of test scores indicates that (1) there were statistically significant improvements in student performance in writing and English language arts following implementation of the laptop program, with students increasing test scores from third to fourth grade more after the program was implemented than before; (2) at-risk students increase their test score performance more than non at-risk students, thus helping close achievement gaps, and (3) test score gains were greatest for students who used the laptops the most. We explain each of these findings in turn.

(1) Overall Writing and Language Arts Gains

The laptop program was first introduced in January 2008. Netbooks were thus available to fourth grade students for part of the 2008-2009 school year and all of the 2009-2010 school year. We used a matched cohort analysis to investigate how individual students test score results on the California Standards Test (CST) English Language Arts tests changed from third grade to fourth grade in spring testing for three different years:

- 2007 (third grade) to 2008 (fourth grade) [no laptop program]
- 2008 (third grade) to 2009 (fourth grade) [partial laptop program]
- 2009 (third grade) to 2010 (fourth grade [full laptop program]

In conducting this analysis, we totaled five of the six subscores: Word Analysis, Reading Comprehension, Literary Response and Analysis, Writing Strategies, and Writing Conventions. (The sixth subscore—Writing Prompts—is discussed separately below.) We first totaled the Writing Strategy and Writing Conventions scores to come up with an overall Writing score, and then totaled the five subscores to come up with an overall English Language Arts score.

In both Writing and English Language Arts, there was greater growth from 2008 to 2009 (when the laptop program was partially implemented) than in the previous year (when there was no laptop program), and then even greater growth from 2009 to 2010 (when there was full implementation (see Figure 1). Specifically, writing growth from 2009 to 2010 was 23% higher than the growth from 2007 to 2008 and 10% higher than the growth from 2008 to 2009. Total English Language Arts growth for 2009 to 2010 was 33% higher than from 2007 to 2008 and 8% higher than from 2009-2010. In other words, after full introduction of the laptop program, students' English Language Arts scores grow from third to fourth grade a full one-third faster than before the program was introduced.
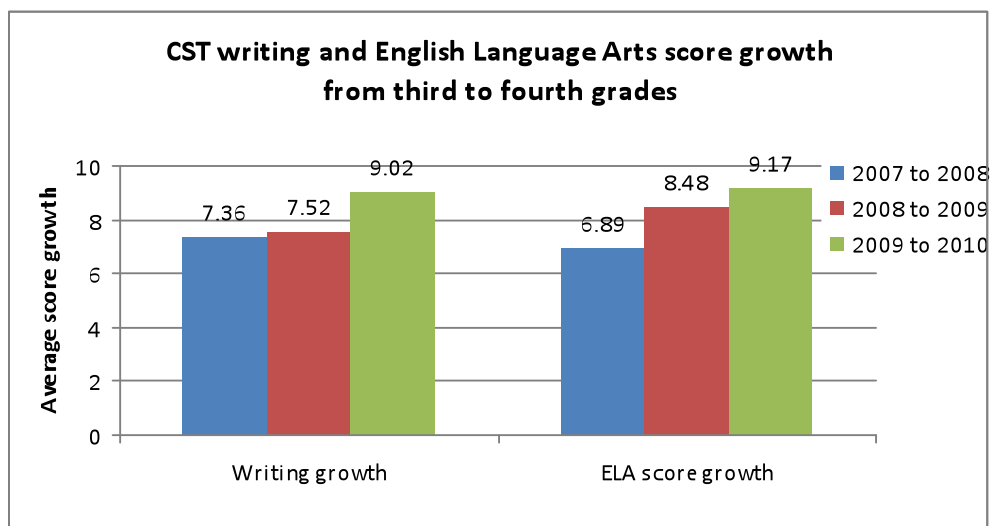

Fig 1. CST writing and English Language Arts score growth from third to fourth grades

Further, these year-to-year gains were consistent in each of the two writing subscores, as seen in Figure 2.
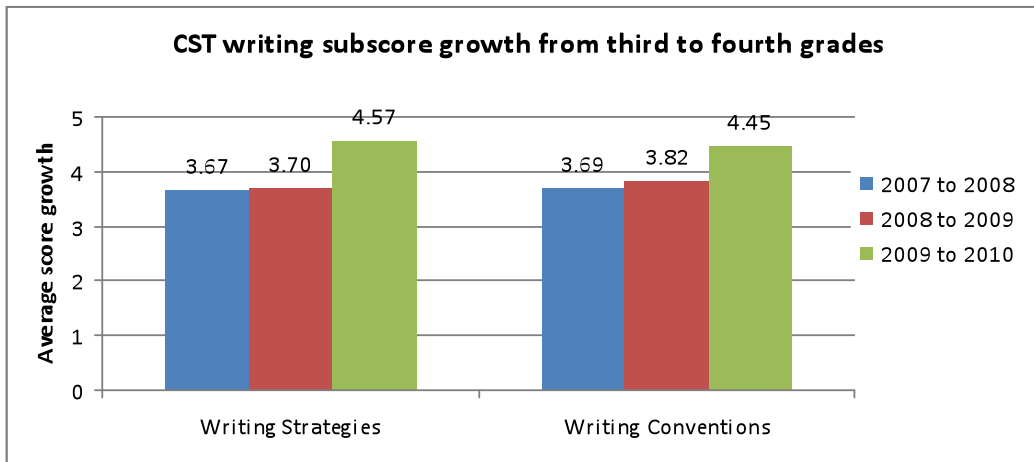

Fig 2. CST writing subscore growth from third to fourth grades

The sixth subscore, Writing Prompt, is perhaps the most relevant, since it is based on writing of an actual essay. This subscore was excluded from the above analysis, since (a) it is only given in fourth grade, not third grade (thus making it impossible to compare change from third to fourth grade) and (b) it was not given in 2010, due to budget cuts. While we are not able to compare score changes from third grade to fourth grade, we can compare score changes among fourth grade students from year to year (see Figure 3). The Writing Prompt subscore increased by .68 points on average in the district from 2007 to 2008 before the laptop program was introduced. From 2008 to 2009, when the laptop program was partially implemented, the Writing Prompt subscore increased by .78 points. In other words, in the first (partial year) of the laptop program, Writing Prompt scores increased 15% more (.78/.68) from the previous year than they had increased in the previous year. Given the fact that the other two writing subscores increased much more dramatically in the second (full) year of the laptop program than the first (partial) year (see Figure 2 above), it is reasonable to assume that the same would have taken place with the Writing Prompt scores, which are probably the score most sensitive to laptop use, since the score measures actual essay writing. Unfortunately, since California removed the Writing Prompt score in 2010, this cannot be analyzed.
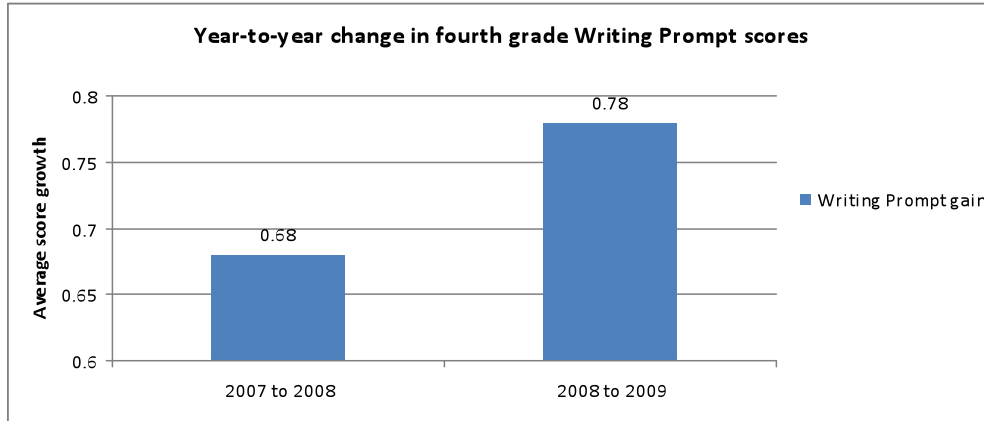
Fig 3. Year-to-year change in fourth grade Writing Prompt scores

(2) Writing Gains Among Diverse Students

We also analyzed changes in students' English Language score among different groups of students. Figures 4, 5 and 6 show the test score gains from third to fourth grade by students according to income level (comparing students who received and who do not receive free or reduced price lunch), by ethnicity (comparing Hispanics to Whites, which represent the two largest ethnic groups in the district) and by language status (comparing English language learners to those who are not ELLs). In each case there was a catch-up effect from 2007-2008 (before the laptop program was implemented) to 2009-2010 (after full implementation of the program), with the at-risk group of learners performing comparatively better in improving their test scores after the laptop program. This is especially important given the well-known fourth grade slump in California, in which at-risk students usually start to fall further behind in upper elementary school. In SUSD, the laptop program has helped ameliorate this fourth grade slump by bridging achievement gaps by income level, ethnicity, and language.
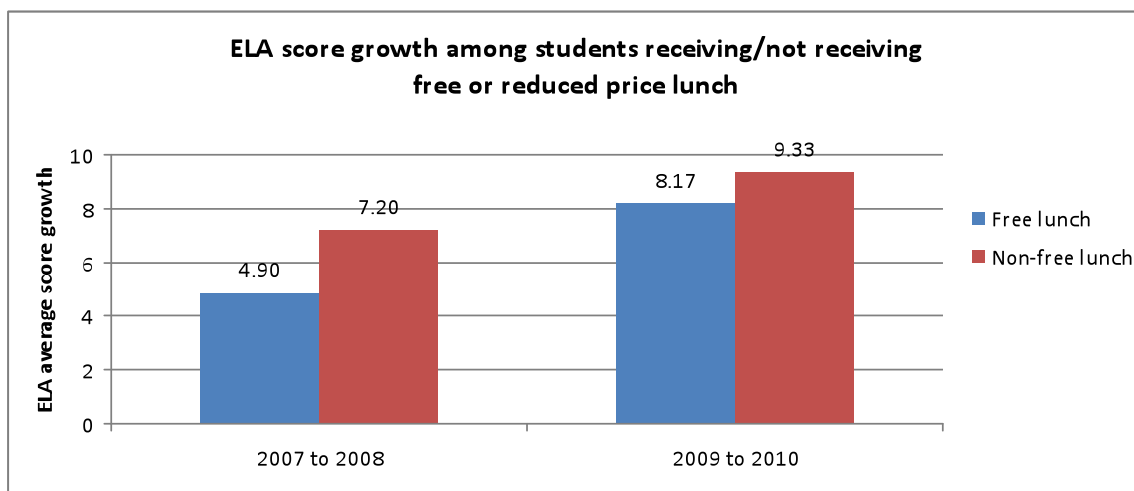

Fig 4. Test score growth among students receiving/not receiving free or reduced price lunch
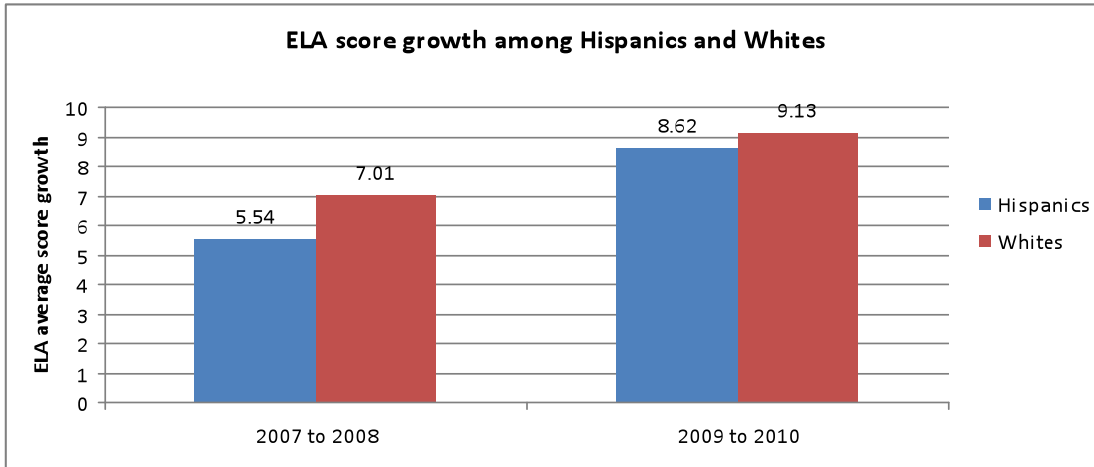
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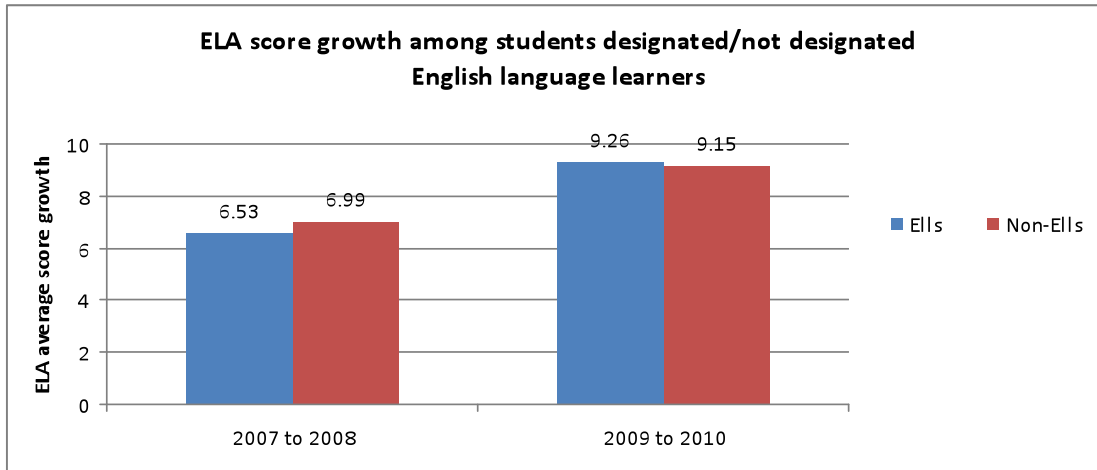Fig 5. Test score growth among Hispanics and Whites

Fig 6. Test score growth among students designated/not designated English language learners

(3) Relationship of Amount of Laptop Use to Writing Gains

Finally, we used the District Writing Test, which is given in both fall and spring and scored on a four-point scale, to investigate how much individual fourth grade students' test scores improved from fall to spring in 2009-2010 and how that related to the amount of laptop use. Students were divided into four quartiles according to how much they reported using laptops for learning. We then calculated a mean post-score for students in each quartile of computer use, taking into account all their demographic information as well as their pre-score. In other words, the final result, in Figure 7, shows what the average post-score is for each quartile of students (by amount of computer use) assuming that they started with the same pre-scores and the same other demographic background. As seen in the figure, the post-score increases for students in the third quartile (who use laptops somewhat more than a typical amount) and increases then again for

students in the fourth quartile (who use laptops the most). This provides further evidence that it is use of the laptops that is contributing to improved writing.
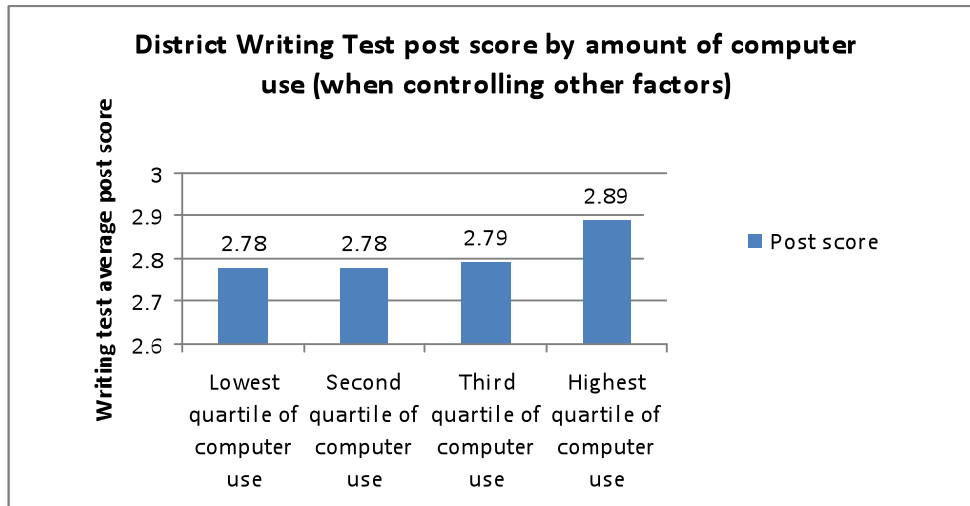

District Writing Test post score by amount of computer use (when controlling other factors)

Writing test average post score

2.78 — Lowest quartile of computer use
2.78 — Second quartile of computer use
2.79 — Third quartile of computer use
2.89 — Highest quartile of computer use

■ Post score

Fig 7. Post score by amount of computer use (when controlling other factors)

Conclusion

Our observations and interviews, survey results, and analysis of test score data all point to the same conclusion: the SWATTEC program has had a positive effect on teaching and learning of writing and English language arts in SUSD. Furthermore, while all demographic groups benefited from the program, the greatest benefit accrued to those students most at risk. These are impressive achievements, given the program is still in its early stages of implementation.

We have not conducted a cost-benefit analysis to see how these results might compare to other benefits that could be received at a similar cost. However, since the district uses a low-cost netbook and, for the most part, free open source software, the overall cost is low and the ratio of benefits to cost appears high.

Results to date suggest that the program should be continued and, if possible, extended to additional grade levels.

About the Research Team

Dr. Mark Warschauer is Professor of Education and Informatics at the University of California, Irvine, and director of the university's Digital Learning Laboratory and its Ph.D. in Education program. Dr. Warschauer has published eight books and more than 100 papers on technology and learning, including, most recently, *Laptops and Literacy: Learning in the Wireless Classroom* (Teachers College Press, 2006) and *Technology and Social Inclusion: Rethinking the Digital Divide* (MIT Press, 2003).

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Dr. George Farkas is Professor of Education and Sociology at UCI and a Fellow of the American Educational Research Association. Dr. Farkas is one of the nation's top experts on statistical methodology of educational evaluation and is currently principal investigator of research grants from the Institute of Education Sciences and the National Institute of Health.