PUBLIC POLICY INSTITUTE OF CALIFORNIA

Upgrading Technology Infrastructure in California's Schools

Technical Appendices

CONTENTS

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Appendix A. Analyzing the CDE survey data

In fall 2014, K–12 HSN conducted a state wide survey to assess schools' technology infrastructure and readiness for online testing. A random sample of 500 schools was selected and the 48 County Offices of Education in which these sample schools were located were subcontracted to help with the collection of the survey. A total of 442 schools (88 percent) responded to the survey and we merged the survey data to CDE's demographic, educational needs, performance and parental education data. A large majority of the surveys were completed by school principals (47%) and IT directors, network managers, and IT technicians (32%). Table 1 summarizes the results and there is no difference between survey sample and state average in all observable characteristics.

TABLE A1
Representativeness of the CDE tech survey

Survey representative check	Survey sample	State	p-value of difference
Total Enrollment	627	601	0.3309
% Asian	0.13	0.12	0.3872
% Black	0.07	0.08	0.3857
% Hispanic	0.52	0.52	0.9277
% White	0.28	0.29	0.2836
% Female	0.47	0.47	0.7689
% LEP	0.25	0.25	0.865
% FRPL	0.6	0.61	0.4973
API (2012)	792	787	0.4292
Parental education: High school graduates	25	25	0.5665
Parental education: Some college	23	24	0.1549
Parental education: College graduates	18	18	0.8508
Parental education: Graduate school	12	11	0.4495
Graduation rate (2012)	79	79	0.994
Graduation rate (2013)	79	80	0.7097
% at or above proficiency (CST Math, 2012)	60	59	0.5021
% at or above proficiency (CST ELA, 2012)	56	56	0.3535

SOURCES: California Department of Education, various years.

Appendix B. Factors Affecting Network Challenges

TABLE B1
Factors affecting network challenges

	Challenge areas				
	High density wireless network	Bandwidth (wired and wireless)	Overall network	Devices	No challenges
student enrollment (00)	0.0385*	0.0104	-0.0257	0.0116***	0.0008
	[0.022]	[0.019]	[0.017]	[0.004]	[0.002]
enrollment squared	-0.0017**	-0.0004	0.0010		
	[0.001]	[0.001]	[0.001]		
school location: rural	0.2030	-0.0792	0.0227	-0.0641	0.0049
	[0.134]	[0.093]	[0.105]	[0.053]	[0.036]
% Hispanic	-0.5271**	-0.3024	0.0047	-0.4840***	-0.2031***
	[0.238]	[0.246]	[0.204]	[0.165]	[0.070]
% LEP	0.7527***	0.3381	-0.0981	0.0010	0.0330
	[0.248]	[0.212]	[0.175]	[0.167]	[0.064]
% FRPM	-0.2713	-0.6638***	0.0649	0.5508***	0.1222*
	[0.260]	[0.246]	[0.201]	[0.195]	[0.070]
% proficient in CST math (2012-13)	0.0033	-0.0011	0.0001	-0.0021	-0.0030***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.001]
% parents with a college degree or higher	-0.0040**	-0.0084***	0.0012	0.0036*	0.0019*
	[0.002]	[0.002]	[0.001]	[0.002]	[0.001]
Observations	264	264	264	264	283

SOURCES: Student enrollment, % Hispanic, % LEP, % FRPM: California Department of Education, 2013-14. % CST proficiency, % parents with a college degree or higher: California Department of Education, 2012–13. School location: Statewide connectivity survey, California Department of Education/K–12 HSN, 2015.

NOTES:1. Numbers are marginal effects taken from a probit model of regressing each challenge area on a set of school characteristics. 2. Robust standard errors in brackets. 3. Full model also include % Asian and % Black. 3. For high density wireless network, the relationship between school size and the probability of facing challenges is quadratic and the tipping point is estimated to be around 1,200 students, and statewide approximately 11 percent of schools are above this threshold. The inverse u-shaped form is identified as follows: first run a quadratic regression and identify the point at which the u-shape maxes out; then run a linear regression up to the tipping point (1,200) and another from that point on wards. The second line is negative and significant at 5% level.

Appendix C. Estimating the Costs of Upgrading

This appendix explains how data from a number of different sources, along with a collection of assumptions, are combined to produce the cost estimates that appear in the report.

The cost estimates presented here are a gap estimate—an effort to assess the gap between where school technology currently stands and what it would take in terms of dollars to reach a particular performance standard for all schools. The cost estimates presented here, then, are not the total costs of supporting technology infrastructure in the schools, but the *additional* expenditures that would have to be made to reach a desired performance standard. To determine the current status of technology infrastructure, we relied upon the 2015 Statewide Connectivity Survey, a representative survey conducted by the K–12 High Speed Network (K–12 HSN) and California Department of Education (CDE). A detailed discussion about the representativeness of the survey is included in Appendix A.

We divide costs into three areas: bringing broadband access from a provider into the school, providing devices to the students, and maintaining the investment with IT staff.[1] A detailed discussion for each area is listed below:

Connectivity

Connectivity goals. Our baseline goal is to connect all schools at a speed of 100 kbps per student, which is the minimum standard set by the White House and the State Educational Technology Directors Association (White House, 2013; SETDA, 2012). Currently 1,884 out of 10,393 schools are connected below 100 kbps per student. Our target goal is 1000 kbps per student, which is the level of connectivity needed to adequately participate in a digital learning environment (ConnectEd 2015; SETDA 2012). Approximately 60 percent of schools fall below the target standard, some of them significantly.

Connectivity costs. Our connectivity cost estimates build upon the approach first presented in the California Department of Education's (CDE) Broadband Cost Estimator (2015).[2]

Devices

Device goals. Unlike connectivity, the goal or the optimal number of computing devices has been less clear; however, in recent years, an increasing number of schools have embraced the idea of 1:1 computing, i.e., providing one computing device to every middle and high school student. Consequently, our baseline scenario aims to bring extra devices such that every middle and high school is at 2:1 ratio; our target scenario aims to provide one device for every middle and high school student. In both scenarios we have left elementary schools unaffected, and including them would drive up the costs significantly. Statewide, 55 percent of middle and high schools do not meet the 2:1 threshold and 85 percent of middle and high schools are above the 1:1 threshold.

Device costs. We assume a four-year cycle for computing devices, which is industry standard. In Year 1, we assume that schools above 2:1 (or 1:1 in target scenario) purchase new devices to meet the desired ratio; and starting in Year 2, about a quarter of devices are being replaced each year. For simplicity we do not replace existing devices in year, which may drive the costs up. Unit cost per device varies depending on the types of

[1] A complete technology infrastructure also includes costs on software (such as firewall, operational systems), which we were unable to price in this report. In other words, our cost estimates should server as the lower bound estimates.

[2] The CDE also attempted to estimate the additional resources needed to bring school technology up to a particular standard. Their estimates, however, did not include the cost of providing devices to students and the resources needed to provide IT support. We include those here.

purchase. For our analysis, we use a weighted average after taking into consideration the types of devices in schools. Specifically, according to CDE/SBAC's Technology Readiness Survey Tool, the device breakdown is: 54% desktop ($400 or above), 15% laptops ($300 or above), 5% notebooks ($200 or above), 3% tablets ($259 or above for iPads, $339 on average for Chromebook) and our weighted unit price is $280, after conversations with education sales department at leading companies.

Staffing

Staffing targets. The optimal IT staff to device ratio varies from industry to industry and one of the most cited research studies recommended a range of 1 FTE IT technician for each 80 to 110 devices, which, after conversations with school and district IT directors, seems too high for most educational settings. For our baseline scenario, we aim to increase the current IT-device ratio (1:570) by nearly half (1:300), which still is below industry median (1:200). For our target scenario, we still maintain the 1:300 IT-device ratio, but reduce student-device ratio to 1:1.

Staffing costs. To determine the number of IT positions needed, we use the following formula:

(# projected students/student-device ratio) * staff-device ratio # existing staff position

where student enrollment is projected by the California Department of Finance (2015); and the rest are from the K–12 HSN statewide connectivity survey. Average IT technician salary, $61,830, is from the Bureau of Labor Statistics Occupational Outlook Handbook (2014).

Additional Costs: Teacher PD

Excluded from our estimates are the costs of providing professional development to teachers to enable them to successfully integrate a particular level of technology in their classroom. The decision to exclude these costs stems from the fact that (1) we do not have a sense of what constitutes an adequate level of professional development relative to a particular performance standard, and (2) we do not know what level represents the current capacity of teachers relative to using technology. In short, we did not have a starting nor ending point from which we could build an estimate. The National Center for Education Statistics (2009) reported that nationwide public school teachers on average spend 9 hours per year on technology related training. If the same is true for California, then we estimate that an additional $136 million is needed each year for teacher professional development:

# of teachers * foregone hourly wage * hrs spent on professional development

where the number of teachers (295,800) and average teacher salary ($74,090) are from the California Department of Education (2015).

Similarly, we did not include additional training for IT staff.

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