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Large-scale 1:1 computing initiatives: An open access database

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ABSTRACT

This article details the spread and scope of large-scale 1:1 computing initiatives around the world. What follows is a review of the existing literature around 1:1 programs followed by a description of the large-scale 1:1 database. Main findings include: 1) the XO and the Classmate PC dominate large-scale 1:1 initiatives; 2) if professional development was conducted within a 1:1 initiatives, it was done at the onset of the project by venders of the hardware; 3) funding for 1:1 initiatives appears to be provided initially but not as a reoccurring expense.

Keywords: *1:1, BYOD, laptop, database, ICT4D, One Laptop per Child, OLPC, Center for Advanced Study of Technology Leadership in Education, CASTLE*

INTRODUCTION

From those living in affluent suburbs of Los Angeles, California to those living in rural sub-Saharan Namibia, digital revolutions have drastically changed what is possible in educational systems. Globally, our lives are becoming more digital, more technologically suffused, and more dependent on gaining and mastering skills that require the use of digital tools. One technology that is becoming more and more prevalent across the globe is the laptop. Laptop initiatives are propelling educational change with the intent of providing benefits that include improving academic achievement, increasing equity of access to digital resources, increasing economic competitiveness by preparing students for today's workplaces, and transforming the quality of instruction. These initiatives predominantly focus on providing every child in a given system with one digital device.

At the 2005 World Summit on the Information Society, Nicholas Negroponte, founder and chair of the Massachusetts Institute of Technology (MIT) Media Lab, introduced the world to the possibility of a $100 USD laptop computer. Soon thereafter, this laptop computer was developed and became known as the $100 Laptop™, the Children's Machine™, and now the XO™. With a focus on children in the less developed world, the One Laptop per Child™ (OLPC) initiative aims to empower children through education (OLPC 2012b). Since its inception, over 2.5 million XO™ laptops have been deployed in countries such as Peru, Rwanda, Haiti, and Mongolia (OLPC 2012a). Other organizations have joined the cause of providing low-cost computing devices to children, particularly those in less developed nations. Intel™, for example, has distributed over 7 million of its Classmate PCs™ to youth on nearly every continent (Intel 2012). In India, the national government has begun to introduce the Aakash 2™ tablet computer at a cost of $40 USD per student (BBC 2012).

The OLPC, Intel, and India initiatives build on various preceding programs already started by schools and governments in more developed countries. These initiatives in more developed nations have shown there is a great interest in efforts that result in a 1:1 ratio of mobile computers to students. As far back as 1986, the Apple™ Classrooms of Tomorrow project provided both students and teachers with two computers – one for home and one for school (Dwyer 1994). Some believe that the 1989 1:1 program at the Ladies' Methodist College in Australia may have been the earliest one device per one student program in the world (Bebell 2005). More recently, in the United States the state of Maine has been implementing a statewide 1:1 deployment since 2001. The state of Maine now gives every student in grades 7-12 a computing device (Maine Learning Technology Initiative 2012). In Iowa, a more recent grassroots movement has resulted in approximately 140 school districts - over a third of the state's total - giving their students a computer (N. J. Sauers 2012, pers. comm., 18 October). The Australian province of New South Wales is now working with Lenovo™ to distribute laptops to every student in Years 9-12 (New South Wales Government 2012). Around the world, countless schools and school districts are implementing small pilot or full-grade 1:1 programs involving tablets, netbooks, or laptops. Such initiatives continue to proliferate at a swift pace. In numerous locations across the globe, 1:1 computing for youth clearly is an idea whose time has come.

1:1 COMPUTING FOR CHILDREN

Despite the growing deployment of 1:1 student computing initiatives worldwide, little is known about the prevalence, scale, and scope of these programs. Nor is there even a common agreement about what constitutes "1:1 computing." At its most basic definition, "1:1" simply describes a ratio of devices to the number of students. Each student thus has one device in his or her hands. The confusion arises, however, when we begin to look more closely at these definitions. For example, there is no agreed-upon definition of a "computing device," which could mean a laptop computer, a netbook, a tablet computer, or even a smartphone. Within the educational information and communication technology (ICT) community, there often is disagreement about how capable a device must be in order to meet the minimum requirements for an adequate 1:1 initiative (Solomon 2005; Quick 2010).

Additionally, educators disagree about the minimum level of students' access to devices. Some educators argue that a program is not truly a 1:1 initiative unless students are able to take the device home on evenings and on weekends (Oppenheimer 2003; Papert 1992, 1996). Others consider it sufficient if students use computers daily or just have access to a classroom set of computers (typically a mobile cart of laptops, netbooks, or tablets) (Solomon 2005).

Finally, there appears to be a growing interest in - as well as growing disagreement about - bring your own technology or device initiatives (Florence 2012). These BYOT (or BYOD) programs rely on families to provide computing devices to students instead of the schools or other entities. Some educators argue that these types of programs are not true 1:1 initiatives, even when schools supplement the programs by providing devices for lower-income students (McLeod 2012; Stucke 2012).

Regardless of the definitional confusion, governments and school systems continue to forge ahead with 1:1 initiatives in an attempt to improve academic achievement, increase equity, enhance economic competitiveness, and/or transform learning processes (Penuel 2006). Unfortunately, notwithstanding their history, the scholarly literature on 1:1 student laptop programs is fairly sparse; particularly for large-scale programs such as those we describe here. One attempt was made by Derndorfer (2011) to catalogue all 1:1 initiatives and their evaluation metrics. However, Derndorfer's effort resulted in only 17 entries from 14 countries. Much of the research that does exist involves only a few classrooms or schools and the results to date have

been highly variable (Sauers & McLeod 2012). Bebell and O'Dwyer (2010) noted that the discrepancy in results may be because the term "1:1" often simply refers to the availability of technology as a ratio to students and fails to encompass pedagogical changes, administrative supports, learning outcomes, and other implementation concerns. Outcome variability also may have to do with the fact that much of the 1:1 research has focused on programs that were in their first two years of implementation (Drayton, Falk, Stroud, Hobbs & Hammerman 2010).

To date, the most significant academic gains from 1:1 programs seem to be related to students' writing skills. Various studies have found improvements in students' writing scores after being immersed in a 1:1 program (Bebell & Kay 2010; Gulek & Demirtas 2005; Lowther, Ross & Morrison 2003; Silvernail & Gritter 2007). Other studies have identified gains in both writing and literacy skills (Suhr, Hernandez, Grimes & Warschauer 2010). A few research studies have found that students in 1:1 laptop programs have better science achievement compared to their non-1:1 peers (Berry & Wintle 2009; Dunleavy & Heinecke 2008; Siegle & Foster 2000). Although there is less research on the impacts that 1:1 programs have had in other content areas, studies do exist that appear to illustrate learning improvements due to 1:1 programs in math, reading, and other subjects (Lei & Zhao 2008; Light, McDermott & Honey 2002; Shapley et al. 2006).

In addition to academic improvement, additional reported benefits of 1:1 programs include changed student and teacher behaviors and attitudes. Multiple studies have reported that student engagement has increased as a result of 1:1 programs (Bebell 2005; Lemke & Martin 2004a, 2004b; Mouza 2008; Russell, Bebell & Higgins 2004; Shapley et al. 2006; Warschauer & Grimes 2005; Zucker & McGhee 2005). For example, Bebell and Kay (2010) analyzed the impact of a 1:1 program on five middle schools in Massachusetts. Teachers at those schools reported that students were more engaged and were more motivated when completing tasks using laptops. Changes in teacher behaviors also have been reported as a result of educators' involvement in 1:1 programs. For instance, in a 447-classroom study, Dawson, Cavanaugh and Ritzhaupt (2008) analyzed the impact of Florida's Leveraging Laptops Initiative and found that teachers in 1:1 programs made greater use of project-based learning and collaborative learning. They also found that there was a decrease in teachers' use of direct instruction techniques. These changes in both teacher and student behavior certainly are factors for educators and policymakers to consider when deciding whether or not to initiate 1:1 programs for students.

Weston and Bain (2010) argued that 1:1 programs may have more impact on making positive change in schools than any other reform effort. But not all educators are convinced that 1:1 programs are beneficial. A few schools have even discontinued their 1:1 initiatives (Hu 2007). In general, however, both past experiences and scholarly research seem to be fairly positive, even if a large base of literature is unavailable at this time.

METHODOLOGY

As an international collaborative effort of the Center for the Advanced Study for Technology Leadership in Education (CASTLE) (www.schooltechleadership.org), which is housed at the University of Kentucky, USA, the researchers sought to create an open access database of all large-scale 1:1 efforts around the world. For purposes of this study, we defined a '1:1 initiative' to be one in which children were given a computing device more powerful than a smartphone - that is, a laptop, netbook, or tablet computer - and had access to that device both in and out of school, including evenings or weekends. This definition eliminated BYOT or BYOD programs as well as initiatives that merely provided computer labs or carts to students during the school day. In this study we also defined a 'large-scale' 1:1 implementation to be one that was regional, statewide, or nationwide. Local school- or district-level implementations thus were excluded from this study.

Operating within these definitions, we began the project by compiling a list of the 193 member countries of the United Nations. Each researcher was responsible for all pertinent information for a given number of assigned countries. After receiving the country assignments, the researchers searched educational databases including ERIC, EBSCO, Education Full Text, and Google Scholar. We also used Internet search engines (e.g., Google) looking for websites, news articles, reports, stories, or any other documentation that indicated that a country, state, province, or region within a country had implemented a large-scale 1:1 educational initiative. Once an initiative was determined to exist, we searched broader and deeper in order to collect as much information as possible about that particular 1:1 deployment. For example, we analyzed the websites of OLPC and Microsoft to better understand their particular initiative in various countries.

As we gathered information and resources, we began to compile the database to organize our findings (see http://goo.gl/S9oim). Data categories were determined *a priori* and included the type of device, total number of units deployed, sponsoring program, start date, and amount of funding allocated. Other data collected included evidence of professional development for teachers, professional development for leaders, and Internet accessibility for that program within the given country. It is important to note that not all of these data were available for every known 1:1 initiative. Nevertheless, we felt these categories would be important for future analysis so we collected any relevant information that was available.
To ensure the validity of the data, each item entered into the database required a justificatory citation (see http://goo.gl/r5jr0). In the event of conflicting data for a country or region, the most recent documentation was used to support inclusion of the data in the database. After each researcher entered all data, they were double-checked by that same researcher. After this point, a second researcher conducted a third quality check to confirm and clarify that the data in the database matched those from the cited sources. The second researcher also conducted an additional search to ensure that new, updated data were not available. At the conclusion of the data collection and validation stage, a third researcher went back through the database to ensure consistency of data formatting and presentation.

THE DATABASE

The database has multiple components and can be used for numerous research, policy, and analytical purposes. In the following section, we describe the various components of the database project. These elements include the database itself, supporting citations, contacting the authors, submitting updates and revisions, and using the Google Map feature.

Database Components

The database has multiple components that can be used in a variety of ways. The website houses some representations of the information from the current database (see http://goo.gl/zaqfW). The database and its components are housed on the site with an open access copyright license so that visitors can extract data, contribute to the citations list, edit or add to the database, and so on. At the bottom of the site, four options are currently available to visitors. Figure 1 is a screenshot of the navigation options on the webpage of the database that is available at http://jaysonrichardson.com/projects.

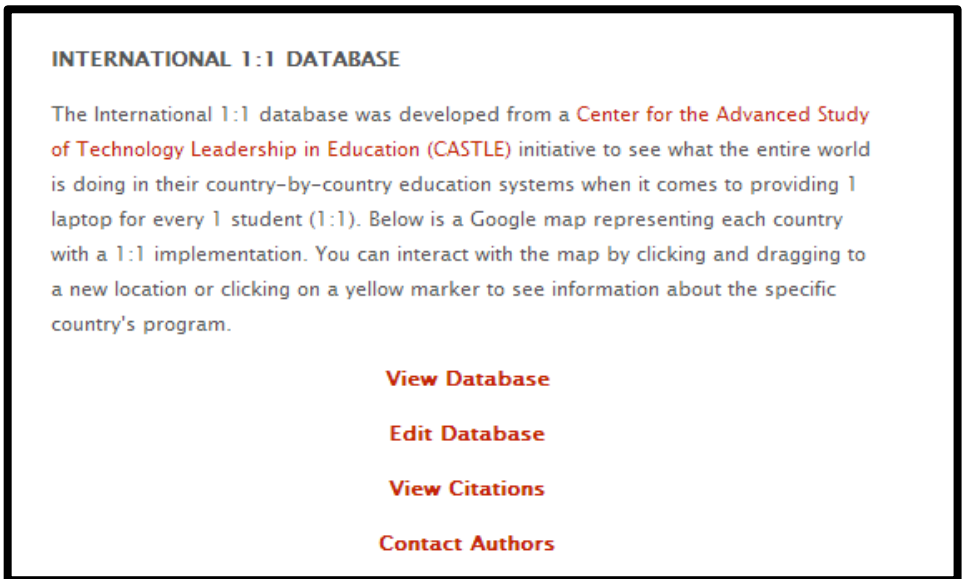

***Figure 1**. Screenshot of database home screen*

The first option seen in Figure 1 is *View Database*. Clicking this link opens the database with the most current data for each country. The second option (*Edit Database*) opens an editable version of the database where visitors can submit changes and edits. Once those edits are confirmed by the authors, the data will be entered into the static database. Edits to this spreadsheet are automatically and instantly submitted to the researchers. We used this confirmatory mechanism to increase sustainability while maintaining the reliability of the database. Figure 2 shows a screenshot of the actual database in either static or editable form.

Region	Country (color coded by region)	Large Scale 1-to-1 Initiative	Device	Grades	Number of units	Started	Program
Middle East	Afghanistan	Yes	XO Laptops	4,5,6	4,950	2008	OLPC
Europe	Albania	No	-	-	-	-	-
Africa	Algeria	No	-	-	-	-	-
Europe	Andorra	No	-	-	-	-	-
Africa	Angola	No	-	-	-	-	-
Central America	Antigua and Barbuda	Yes	Lenovo Laptops	Primary & secondary school teachers	400	2011	Technology for Education 20/20
South America	Argentina	Yes	Classmate PC	Secondary	2,045,254	2007	OLPC
Asia	Armenia	Yes	XO Laptops	Elementary	3,600	2011	OLPC
Oceana (Australia, New Zealand, Polynesia)	Australia	Yes	XO Laptops	9,10,11,12	911,000	1990	OLPC
Europe	Austria	Yes	XO Laptops	4	25	2008	OLPC
Asia	Azerbaijan	No	-	-	-	-	-
Central America	Bahamas, The	No	-	-	-	-	-
Middle East	Bahrain	No	-	-	-	-	-
Asia	Bangladesh	No	-	-	-	-	-
Central America	Barbados	Yes	XO Laptops	2 and 3	200	2009	OLPC
Europe	Belarus	No	-	-	-	-	-
Europe	Belgium	No	-	-	-	-	-
Central America	Belize	No	-	-	-	-	-
Africa	Benin	No	-	-	-	-	-
Asia	Bhutan	Yes	XO Laptops	Primary	220	2009	OLPC
South America	Bolivia	Yes	XO Laptops (Lenovo)	Primary (Teachers)	2,000 (130,000)	2009 (2011)	OLPC (Government)
Europe	Bosnia and Herzegovina	No	-	-	-	-	-
Africa	Botswana	No	-	-	-	-	-

***Figure 2**. Screenshot of 1:1 database*

The database also categorizes nations by their geographical region. Using regions enables another filter opportunity to keep track of regional initiatives, such as OLPC Oceania and OLPC Pacific. A cell that is blank signifies that we were unable to locate information for that country for that particular data point. It is possible and probable that more data exists but the researchers were simply unable to locate the data.

The third option allows visitors to *View Citations*. Users who click on this link will be taken to a separate document with links to all of the references used to compile the database. Figure 3 shows how the citations document is organized alphabetically by country.

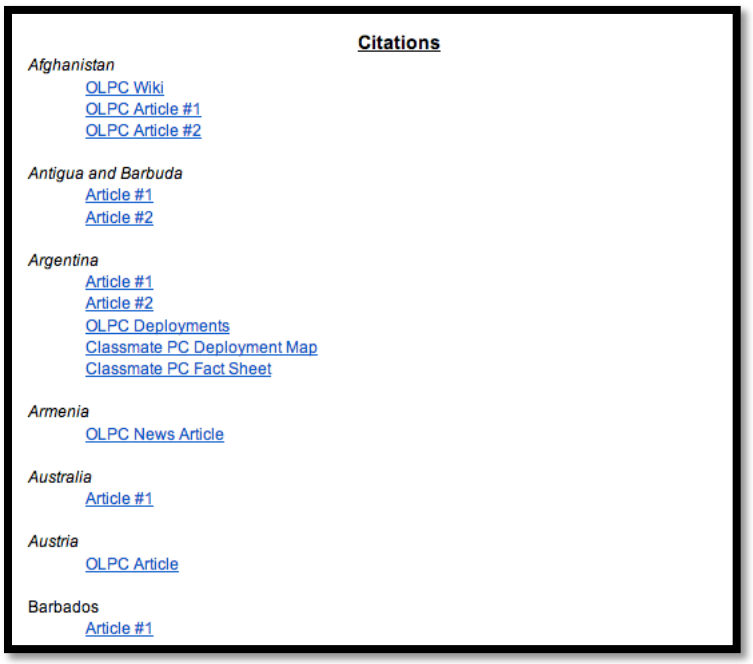

***Figure 3**. Screenshot of citation page*

The fourth and final option allows visitors to the site to *Contact Authors*. Here visitors are encouraged to contact the researchers with any questions or suggestions about the database. Being that this project is a collective effort, communication and continued input will be pivotal in the maintenance of such a database.

Finally, as shown in Figure 4, an interactive Google Map of all 1:1 initiatives around the world is provided on the website. This map will be updated periodically as changes are made to the database. Each country is represented with a yellow digital marker. By clicking on the marker, information regarding that country's 1:1 initiative will be displayed. The Google Map is not intended to represent the total sum of computers in each country but rather just those represented in the database. The map provides a visualization to quickly understand the number of devices in each country compared to the rest of the world. The map includes various functional elements including: zooming in and out, panning across the world, and clicking on the yellow digital markers to access more information regarding each country's 1:1 implementation. If no marker is provided on a country, then no information is currently in the database regarding that country and any 1:1 initiative.

Figure 4. *Interactive Google Map of the database*

ANALYSIS OF DATABASE

The following section describes some preliminary analyses of the data currently found in the database of large-scale 1:1 initiatives. In these analyses we focus on which computing devices are being deployed, how large-scale 1:1 projects have been funded, and how professional development has been implemented for these initiatives.

Computing Devices

The database contains the total number of computing devices being deployed in large-scale 1:1 initiatives for each country. Table 1 shows the total number of devices as well as the market percentage by region. South America is currently the dominant region for large-scale 1:1 laptop initiatives, with 65% of the world market. This is mainly due to Argentina's initiative with Intel, which has resulted in a reported deployment of over 2 million Classmate PCs™ since 2007.

Table 1*: Number and percentage of devices by region*

Region	Number of Devices	Percentage
South America	5,513,254	65.03%
Europe	1,125,745	13.28%
Oceana	913,560	10.77%
Africa	280,985	3.31%
Asia	247,110	2.91%
Middle East	168,580	1.99%
North America	135,358	1.60%
Central America	94,035	1.11%
Total	**8,478,627**	**100.00%**

From the data it appears that at least nine different devices are being used in large-scale 1:1 laptop programs. As shown in Table 2, two devices, OLPC's XO laptop and Intel's Classmate PC™, currently dominate the worldwide market. The Classmate PC™ is most prevalent around the world and is being used in fewer countries but in larger initiatives than the XO laptop. The XO laptop is second most prevalent around the world and is being used in many countries' pilot programs in an attempt to determine the potential benefits of providing laptops to all students and teachers. The XO laptop appears to be in a many different countries at various levels of development.

The OLPC initiative is now deploying its fourth generation computing device and now includes a tablet version as well as a touchscreen version. The textbook-sized laptop offers built-in wireless Internet capabilities, is designed for extreme durability (including resistance to dust and water), and has a unique screen that allows children and teachers to read the screen when using the device outdoors. This is a vital feature since outdoor schooling is not uncommon in developing countries. The XO device can be used with alternative power sources such as car batteries and can be folded in different ways to facilitate use as a laptop or e-book reader. Limitations of the XO laptop include the lack of a hard drive or a CD/DVD player and a limited operating system called Sugar. Variations of the standard XO model allow users to charge them with solar panels or to generate a charge by using an optional hand crank.

The Classmate PC™ is currently in its third generation and differs from the XO laptop in several key ways. First and foremost, it employs Windows XP as its operating system, which allows for greater compatibility with other computing hardware and software. It also has a local hard drive, which makes it easier for users to store files. Like the XO laptop, the Classmate PC™ also has wireless Internet connectivity, USB ports, and a camera that can be used to capture photographs or make videos. One limitation of the Classmate PC™ is that it has a backlit screen, which makes it more difficult to read outdoors and in other high light areas. The newest version, the third generation Convertible Classmate PC™, has a 180 degree camera, touch screen, a water-resistant keyboard, and a 180 degree swivel monitor.

***Table 2**: Devices by number and percentage of all large scale 1:1 initiatives*

Devices	Number of Devices	Percentage
Intel Classmate PC	4,912,354	57.94%
XO Laptop	2,863,663	33.78%
Lenovo Laptop	247,737	2.92%
Linux (NComputing)	180,000	2.12%
Netbook	122,383	1.44%
Apple (iPad and MacBook)	101,150	1.19%
Asus EeePC	51,000	0.60%
Tablet PC	340	0.00%
Total	**8,478,627**	**100.00%**

Lenovo laptops make up about 3% of the world's large-scale 1:1 deployments. Data about the use of Lenovo devices for 1:1 initiatives were rather general in nature, leaving us unable to determine specific device configurations by country. The Lenovo ThinkPad™ is a common laptop that has proven to be durable and lightweight and typically is priced for mass purchasing. Like the Classmate PC™, the ThinkPad™ offers a Windows operating system and thus has more robust computing capabilities than the XO laptop.

Some countries are using NComputing devices. These run on the Linux operating system. The NComputing model utilizes a desktop virtualization and thin client framework that allows for up to six virtual computers to be deployed for each traditional computer. Essentially, the NComputing

device plugs into a stripped-down computer (i.e., the thin client device) and, through Linux software, allows the computer to run its operating software and save data to a hard drive that is then linked to a fully-operational computer.

Apple has deployed over 100,000 MacBook™ laptops and iPads™ through its various large-scale 1:1 initiatives around the world. The iPad™ is a tablet computer designed for use with applications (i.e., 'apps') that can be downloaded from the Apple Store. The MacBook™ is a fully functional laptop computer with a Macintosh operating system. Because of its form factor, innovative software interface, and robust ecosystem of apps, the iPad™ currently has a quick rate of adoption. As of the fall 2011, 600 U.S. school districts have adopted the iPad™ (Donahoo 2011). Some educators criticize its suitability for 1:1 programs citing how laptops have more powerful hardware and more robust software options (Shanklin 2012; Travers 2012).

One of the earliest and most popular netbooks was the Asus EeePC™. It also has tens of thousands of devices employed in large-scale 1:1 programs. In its current form, the Asus EeePC™ is a tablet computer that plugs into a docking station with a keyboard to offer benefits similar to those of a laptop. Students and teachers can use a stylus pen to draw, take notes, and navigate on the screen.

Funding of 1:1 Initiatives

The funding levels for each country's large-scale 1:1 deployments were perhaps the most difficult data to locate. Most of the information that we found focused on the initial allocation of funds. Thus data are usually available only at the inception of the project. Rarely did we find descriptions of continuing funding or subsequent expansion of funding. Some reports simply mentioned that there would be funding, but did not specify the amount. There were some exceptions, however. For example, Paraguay reported a $25 million USD initial commitment for its OLPC program (All Voices 2012). All Voices (2012) also reported that officials in Paraguay later provided an additional $25 million USD for infrastructure and project sustainability.

Funding data were collected for each country. These data however were difficult to locate. In fact, we found investment amounts for only a handful of countries. No data were found for any country specifically regarding: ongoing funding necessary for maintenance and repair of the hardware; for personnel needed to support and train teachers; for marketing, publicity, and communication to stakeholder; or for other sustainability purposes. It is unclear if, with most large-scale 1:1 deployments, these types of expenditures are included as part of the overall funding allocation or whether the initial budgets were allocated wholly on the devices themselves.

Professional Development

Professional development was another data category found in the open access database. We looked for two types of professional development: for teachers and for school leaders. The research is fairly clear that robust professional development is necessary if we want teachers to effectively utilize technology with students for learning purposes (Davis, Preston & Sahin 2009; Drent & Meelissen 2008; Richardson 2011; Richardson, Finholt-Daniel, Sales & Flora 2012; Watson 2001). Scholars also have found that in schools large enough to have multiple classrooms and a principal (or other school leader), professional training for administrators is necessary to ensure effective facilitation, support, communication, sustainability, and other technology-related leadership behaviors (Baskin & Williams 2006; McLeod, Bathon & Richardson, 2011; McLeod & Richardson, 2011; Mooij & Smeets 2001; Richardson & McLeod 2011). In our investigations, we found that training of educators and other individuals is primarily negotiated and designed at the time of purchase. As an example, OLPC (2011) describes that once a commitment has been made by a country to purchase XO computers, the OLPC organization

uses a cascading training model in which it sends its trainers to conduct a pre-deployment training to core members of the government or school system in an effort to cascade the lessons to other stakeholders. OLPC (2011) also provides post-deployment remote support for free. If a project consists of 25,000 or more units, OLPC sends educational and technical support staff to the country for one week to facilitate training. When a country purchases over 50,000 XO devices, it receives the same type of staff support for two weeks with an additional two weeks within a year.

Although professional development for teachers, school leaders, and/or policymakers was included in many of the large-scale 1:1 programs, it was unclear whether that professional development focused on the technical aspects of using the provided hardware and software, on the pedagogical aspects of incorporating potentially powerful tools into the learning-teaching process, or on both. We also were unable to locate more specific details about the timing, content, structure, and other aspects of the provided training for most of the initiatives.

LIMITATIONS AND POSSIBILITIES

As can be imagined, creation of an open access database from such diverse sources proved to be quite challenging. Citations are given for all of the information within the database. However, the sources varied with regard to reliability, credibility, and accuracy. Some sources were informative and precise, such as reports about a given large-scale 1:1 project. Other citations are more ambiguous and/or editorialized. Here is one example of this inconsistency. The OLPC website was approached as an accurate representation for the deployment of its devices. However, we located numerous documents from various countries that contradicted the OLPC website. Judgments had to be made about the sometimes-conflicting data and information. In most instances, we chose to use the most current source for the database (e.g., if a country's newspaper reported that the pace of deployment was slower or smaller in scale than that previously reported by OLPC, we used the country's information). All decisions regarding choice of source was collaboratively done by all authors. As other researchers begin to contribute to the database, citations will be required for any new data that are added to the database. We will review all submitted information, compare it to the current data, and make final decisions on whether or not to change the database accordingly.

Another challenge that we faced was the wide range of information available. Some countries have developed fairly robust systems of reporting information through government institutions and/or media channels. Others are less likely to have avenues for reporting governmental investments, school expenditures, philanthropic activities, and the like. Some countries release very little information about their educational systems in general. For instance, the OLPC website reports Australia as having 4,400 devices in the country. The Australian Government (2011) however says the country has deployed over 911,000 laptops throughout the schools as of the beginning of 2012. A similar issue can be found in Ecuador, where the OLPC initiative map makes no mention of laptops in the country. However, Severin and Capota (2011) report the Ministry of Education as having placed over 4,000 laptops (a mixture of XO laptop and Classmate PC) throughout Ecuador.

Another limitation is one that we choose to view as an opportunity. Given the relative scarcity of information available on many of the large-scale 1:1 initiatives identified through this work, we believe that there are powerful possibilities available for the greater educational technology community to work together to grow this initial database. For instance, researchers who live in or near a country and who are more familiar with local government and media channels may be best suited to identify additional information sources and thus expand the database and increase its reliability. Similarly, numerous information fields from other governmental or international

databases can be combined with those currently in this database to create new analytical value and findings. We already have begun to and will continue to explore these opportunities.

CONCLUSION

This project was the first of its kinds that attempted to comprehensively catalogue all large-scale 1:1 initiatives around the world. As we worked to create an open access, sustainable, robust database that can be contributed to by anyone at any time, we realized that there is a tremendous lack of comparative data on 1:1 initiatives of any size. The data that are available often are incomplete and contradictory, and what is promised at the onset of a large scale 1:1 project often is not what is actually delivered. As a result, data from initial news reports or press releases may not accurately reflect what is actually happening in the field. One potential area of research is to compare what is promised at the onset of a large-scale 1:1 initiative against what is actually implemented, with an eye toward reasons for potential differences such as funding, implementation fidelity, policies, or support structures.

The data that are reported herein focus primarily on numbers of machines, types of machines, and funding levels. Details on professional development for teachers and leaders were less available, and for most deployments, we are uncertain how professional development was structured, sustained, or how it impacts teaching and leadership practices as well as student outcomes. The training that accompanies large-scale 1:1 initiatives is a ripe area for future research.

For the purposes of this project, we standardized on a particular definition of 1:1. In the field, of course, that term connotes a variety of meanings. Educators' and policymakers' belief systems around ubiquitous computing vary widely and reports do not always describe in detail the type of 1:1 program that is being implemented. A 1:1 initiative in one country might mean a laptop for every child that can be taken home. A 1:1 initiative in another region might mean netbooks or tablet computers that children use in their classrooms for an hour or two per day. Further study is needed regarding how 1:1 implementations are localized in certain areas and whether standardized deployment models foster or hinder effective adoption by local educators and children.

This database serves as a starting point for these and other conversations and research initiatives. This area of research is new and fertile and there is much room for growth. It is our hope that other researchers will use and contribute to this database in order to foster our collective understanding of large-scale 1:1 initiatives.

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