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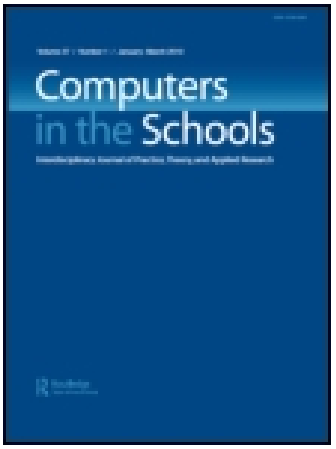

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Common Challenges and Experiences of School Districts That Are Implementing One-to-One Computing Initiatives

Andrew Topper [a] & Sean Lancaster [a]

[a] Grand Valley State University , Grand Rapids , Michigan , USA

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Common Challenges and Experiences of School Districts That Are Implementing One-to-One Computing Initiatives

ANDREW TOPPER and SEAN LANCASTER
Grand Valley State University, Grand Rapids, Michigan, USA

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This article explores the implementation of various K–12 one-to-one computing initiatives to determine if patterns exist. These initiatives are funded in times of limited resources and constitute a serious investment in technology for the schools and districts adopting them. The goals of this study were to understand how and why one-to-one computing initiatives are being implemented, how these initiatives are funded and supported, and expectations or assumptions of stakeholders that are driving adoption of this type of technology. The results suggest that these school districts, and those like them, will face many challenges—some financial, some technical, and some procedural—as they work to integrate technology into instruction and assessment. Common themes or challenges identified from this work, and linked with previous research, include leadership and vision, funding, teacher professional development, and project evaluation.

KEYWORDS one-to-one, 1:1 laptop initiative, computer initiative, one-to-one computing

K–12 schools and districts have taken steps to provide expanded access to technology for students. One such effort is to provide each student with a school-provided laptop, netbook, or tablet computer for use at school and at home. These initiatives, commonly referred to as one-to-one (1:1) computing, address the issue of lack of regular, sustainable access to technology, but come with challenges for realizing benefits. In times of reduced state funding for many K–12 schools, 1:1 computing initiatives represent a significant investment in technology. Without understanding and accounting for

Address correspondence to Andrew Topper, GVSU College of Education, 618f Eberhand Center, Grand Rapids, MI 49504, USA. E-mail: toppera@gvsu.edu

all of these challenges, 1:1 computing initiatives may not realize benefits for stakeholders. The purpose of this research was to explore the experiences of school districts that have implemented 1:1 computing initiatives, why they have chosen to do so, what their expectations are for benefits, how they fund the project, and how they are evaluating the success of these efforts.

RATIONALE

With the growth in using digital media and technology by K–12 students, and wider availability of technology in households, school districts are experiencing pressure from stakeholders to incorporate technology into classroom teaching and assessment. Those districts that have resources may be better able to adopt and use technology than those in rural or urban settings. Districts that decide to adopt and incorporate technology face many challenges that may eventually hinder or restrict potential benefits.

RESEARCH QUESTIONS

Research questions for this study follow:

1. How and why are school districts implementing 1:1 initiatives? How are these initiatives funded?
2. What teacher training and support are provided for these initiatives?
3. What expectations are driving the adoption of this technology in these schools and districts? (Are there explicit expectations for improving student academic achievement?)
4. How are these projects being evaluated for success?

BACKGROUND

Since the 1980s when Apple Computer placed personal computers in classrooms and homes, educators have struggled with the challenges of integrating technology into K–12 instruction and assessment (Dwyer, Ringstaff, & Sandholtz, 1991). One drawback to these efforts has historically been the lack of access to technology on the part of students. One-to-one computing initiatives, also known as "ubiquitous computing" (Zucker, 2004), address this problem by providing each student with his/her own computer. There have been studies of 1:1 initiatives in a variety of educational settings. For example, the Freedom to Learn project provided middle school students in urban and rural settings with laptop computers in Michigan (Urban-Lurain & Zhao, 2004).

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The early results of 1:1 initiatives suggest improvements in student writing skills (Peckham, 2008), motivation and engagement in learning (Grimes & Warschauer, 2008), and development of 21st-century skills, including project development, and research and communication (Penuel, 2006). However, the overall picture of the impact of 1:1 initiatives on student achievement is mixed, and these projects are not without drawbacks and challenges (Dunleavy & Heinecke, 2007; Fried, 2008; Gulek & Demirtas, 2005; Lowther, Ross, & Morrison, 2003; Murphy, King, & Brown, 2007). Reliable networking, technical support, time, and effective professional development (PD) are all required elements of a successful 1:1 initiative. Absent these elements, especially effective teacher PD, it is unclear what impact 1:1 initiatives can have on student learning. Several themes emerged from the research literature.

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Funding

When planning for implementation of a 1:1 initiative, or any other educational technology project, school and district administrators should consider what is known about costs associated with these initiatives and plan for start-up as well as ongoing costs. A report by Quality Education Data indicated that only "37% of the average school's technology expenditures go to computers, printers, and similar hardware. Training, maintenance, online services, etc. are the rest" (Stover, 1999, p. 36).

Funding is an especially critical element of successful 1:1 initiatives in this time of reduced state budgets for K–12 schools. States throughout the United States have been cutting their K–12 funding in the past few years. Alabama cut state aid for education by 18.5% over the past two years; Colorado cut funding by 6.35% for each school district, totaling $260 million; and Georgia cut their K–12 funding by $403 million, or 5% of the 2010 amount (Badertscher, 2010; Center for Public Education, 2010). Massachusetts cut state education aid by $115.6 million, or 3% of the 2010 budget; Michigan cut their school aid budget by $382 million, resulting in a reduction of $165/pupil spending; and Pennsylvania cut basic education funding by $50 million (Damron & Hall, 2010; Khadaroo & Paulson, 2010).

Teacher Professional Development

While traditional, after-school, and summer in-service workshops are helpful for many teachers and clearly provide required technical expertise, they may be insufficient for most teachers engaged in technology integration initiatives. Alternative forms of PD, especially those that focus explicitly on teacher learning, offer promise in promoting and supporting pedagogical change in light of the instructional opportunities technology provides (Hughes & Ooms, 2004).

Project Evaluation

Studies of 1:1 initiatives in K–12 settings identify the importance of a formal evaluation process with clearly identified measures of success (Mouza, 2008). While it may be difficult to use traditional, standardized test scores to measure the impact of technology on student learning, a variety of other measurements hold promise in this regard. These include parents', students', and teachers' attitudes about technology, students' uses of technology at home and in school, and measures of 21st-century literacy skills. These literacy skills include "a person's ability to perform tasks effectively in a digital environment, with 'digital' meaning information represented in numeric form and primarily for use by a computer" (Jones-Kavalier & Flannigan, 2008, ¶ 10).

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METHODS

Between August 2009 and June 2011, researchers identified school districts that were already implementing 1:1 computing, or were beginning the implementation process, in one Midwestern region. Using convenience sampling, the researchers contacted administrators at these districts soliciting participation in this study. Five school districts agreed to participate and the researchers conducted on-site visits to gather data during short (1-hour) semi-structured interviews with key decision makers (i.e., superintendent, principals, and curriculum and technology directors). A mixture of quantitative and qualitative data was gathered from K–12 decision makers who participated in this study. Online surveys of some stakeholders and review of technology planning documents provided additional data for analysis. When available, public documents describing the projects, plans for evaluation, training/support, demographic student data and standardized tests scores were also examined. While the primary source of data—decision-maker interview—represents self-report, and there are obvious limitations with this type of data collection and analysis, other forms of data gathered were used to verify or contest evidence collected during the interviews.

The researchers worked collaboratively with two of the participating school districts to evaluate the implementation of their 1:1 initiative, and with one also providing PD for technology integration drawn from the literature on effective teacher training.

Case studies for each school district were developed using themes identified in the literature. These basic themes allowed the researchers to reach agreement in classifying data, as suggested by Armstrong, Gosling, Weinman, and Marteau (1997). Next, common experiences across the school district cases were examined, and triangulation (e.g., see Denzin, 1970) was used to explore multiple instances of evidence to compare with the findings

TABLE 1 Characteristics of Five School Districts Implementing 1:1 Initiatives in Michigan

District	A	B	C	D	E
Type	Suburban public	Suburban private	Suburban public	Rural public	Rural public
Focus	4–12	HS & MS	6–9	2–12	HS & MS
Year implemented	2009	2005	2009	2008	2010

Note: MS = grades 6–8, HS = grades 9–12.

of other 1:1 research projects. Results were shared with participating school districts.

Case Studies

Tables 1, 2, 3, and 4 identify characteristics of the five school districts that participated in this research. Included are student enrollments and standardized test scores from 2008 for reference. Table 1 provides a brief overview of the five districts. Table 2 provides enrollment figures and standardized test scores for middle school students, and Table 3 provides the same information for high school students in each district.

As referenced in Table 1, the school districts that participated in this study are implementing 1:1 initiatives at a variety of levels, with district C focusing only on grades 6–9. District B has the longest history with 1:1 computing, having implemented their initiative in 2005, while district E started more recently in 2010. Across the five cases, there is a mixture of school types, including rural and suburban public, as well as a suburban private school.

Comparing student enrollment and test score data in Tables 2 and 3, the five school districts (students in district B do not take the state-mandated standardized test) reflect other areas of similarity and difference. District D, for example, has a significantly higher population of students designated as economically disadvantaged (students who receive free or reduced lunches) in the middle school and a slightly higher percentage of students at the high school level. Test scores (taken from 2008) reflect similar percentages of

TABLE 2 Enrollments and Test Scores for Middle Schools in Five Districts (2008)

District	A	B	C	D	E
Enrollment	604	260	535	356	374
Economically disadvantaged students	24.3%	N/A	32.2%	43.8%	28.9%
Reading proficiency	88.6%	N/A	82.4%	81.2%	87.1%
Math proficiency	86.9%	N/A	80.3%	75.6%	86%

Note: District B has no standardized test scores as a private school.

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TABLE 3 Enrollments and Test Scores for High Schools in Five Districts (2008)

District	A	B	C	D	E
Enrollment	615	800	857	369	567
Economically disadvantaged students	21.1%	N/A	22.6%	36.6%	23.5%
Reading proficiency	59.4%	N/A	64.8%	48.9%	54.4%
Math proficiency	57.4%	N/A	60.3%	29.7%	51.7%

Note: District B has no standardized test scores as a private school.

students demonstrating proficiency on the state-mandated reading and math tests, with some variation between the districts at both levels—district D had a lower percentage of proficient students at the middle school level in math as well as lower percentages of proficiency in math and reading at the high school level. Looking at these comparisons provides perspective for a more detailed review, focusing on the key factors identified across the districts with regard to their 1:1 initiatives.

RESULTS

While the experiences of the school districts that participated in this study were different, commonalities and themes emerged from the data analyzed. These commonalities are highlighted and recommendations are provided for possible improvements in these areas for the future.

Examining the five school districts using the research questions drawn from the themes identified in the literature provides a useful perspective on district similarities and differences (see Table 4). In the area of funding (research question 1), a variety of sources were used to purchase required hardware and software, including bonds, Title I and II monies, as well as private donor funding at the private school. With regard to the primary reasoning behind the decision to implement a 1:1 initiative, the districts appeared split between improved access to technology for students (identified

TABLE 4 Characteristics of Five School Districts Implementing 1:1 Initiatives

District	A	B	C	D	E
Funding	Bond	Private + usage fee	Bond	Title I & budget	Bond & Title II
Rationale	Access	Access	Economic	Access	Economic
Professional development model	CFTIG + regular workshops	Workshops + on-site coach	Trainer/on-site coach	Trainer/on-site coach	Trainer/on-site coach
Evaluation plan	Yes	No	No	No	Yes

Note: CFTIG = content-focused teacher inquiry groups.

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as key by districts A, B, and D) and economic benefits (on the part of districts C and E) that might result from a move to digital curricular resources and a reduction in other spending.

Participating school districts' efforts to support and educate teachers in the area of technology were varied (research question 2), with the most common being a trainer-on-site or coaching model for PD. Exceptions included district B, which offered ongoing workshops plus grade/subject-focused teacher groups and district A, which implemented content-focused teacher inquiry groups. District A worked on teacher PD in collaboration with faculty members from a local university, and this represents a unique option that many school districts did not have available.

Expectations for benefits from 1:1 computing (research question 3) for most of the school districts did not include student achievement as measured through standardized test scores, except for district A, which did hope to see test score improvements as a possible benefit of the initiative. Specific expectations cited included improved access to technology, preparation for life after school, and elimination of computer labs.

Regarding a formal evaluation plan (research question 4), school districts A and E had one in place, whereas the other districts had informal or no plans for evaluation. The evaluation plans for districts A and E included measurements of the impact of the initiative on the knowledge, skill, attitudes and actions of staff, changes in classroom instruction, and impact on students' experiences and academic achievements.

Our review of the literature in preparation for this study provided key issues that were critical to successful adoption of educational technology and also a lens through which to examine the common experiences of the school districts that participated in this study.

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Leadership and Vision

One clear indicator of successful 1:1 implementation is a strong commitment to the integration of technology that is communicated, understood, and promoted at all levels of administration. A vision of the role of technology in education, which can be shared with staff and the wider community, is a critical component for success. Absent this commitment, the ultimate success of a 1:1 initiative is difficult to evaluate and may result in contrary or confusing messages. This is not just an issue of management, but communication, developing and sharing a vision for the role of technology, getting support from the community, and establishing clear outcomes of success. In districts that participated in this study, a clear vision of the role of technology in supporting learning and a sustained commitment from administrators at all levels were apparent.

In some cases, this vision was not limited to technology, per se, but was a part of a bigger view of the transformation of education at the K–12

level in light of our changing culture and society. Widespread access and availability of technology have changed the way children and young adults interact, get information, and learn. A clear vision of the role of technology in K–12 instruction and assessment can capitalize on this phenomenon and provide stakeholders with a sense of the future of education in a community and in the broader society:

> Without reservation, it [the laptop initiative] has changed our instruction, our teaching, and our learning more than any other thing we've done. (Superintendent, district B)

Rationale—Economic versus Access/Differentiation

In the long term, an economic argument for a 1:1 initiative may lead to missed opportunities and difficulty providing proof of benefit. Participants in this study indicated that adopting a 1:1 initiative might actually cost more, not less, over a five-year time frame because of expenditures related to maintenance, support, and insurance, among other costs. Beyond the initial expenditures on equipment, software, infrastructure, and training/support, costs associated with textbooks (digital copyrights, access, etc.) and maintenance and repair can represent a significant portion of a district's yearly budget.

The promise of overall reduced costs (e.g., replacing the cost of textbooks), while appealing, might result in failure of the initiative, especially if accurate, honest estimates of all costs associated with technology adoption are not integrated into an adoption plan. Instead, districts in this study used increased access to learning and the Web as a rationale for implementing a 1:1 initiative. This approach, if communicated to stakeholders, holds more promise in the delivery of evidence of benefit than an economic one. Increasing students' opportunities for learning in and out of school via a 1:1 initiative is a measurable benefit to individuals, family members, and the wider community. Access to Web-based resources and development of 21st-century literacy skills are two of the possible benefits realized using this approach:

> We hope to see more of a fluid curriculum, not so textbook-based, with resources available and opportunities for students to use online text and materials, which would be more accessible. (Superintendent, district C)

Teacher Professional Development

While some of the participating districts provided traditional, after-school, or summer PD in support of technology adoption, this may be insufficient for many teachers (Penuel, 2006). Several factors contribute to quality PD: time frame (regularly, during school), cost, duration (throughout the year), and

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focus—a shift from a focus on tools/applications toward ideas for integration in grade levels or subject areas. Each of the districts in this study provided in-school training via technology coaches or integration specialists, or provided grade-level or subject-specific help focusing on integration of technology for instruction and assessment. One district (A) implemented content-focused teacher inquiry groups (CFTIG), with subject area facilitators from a local university in similarly structured PD activities offered during the school day.

The research literature on technology adoption and integration is clear about the essential role of training and support, and ubiquitous computing is no different in this regard. Those districts that fail to recognize and plan for regular, relevant, and ongoing teacher PD are not likely to see widespread use or benefit for most students. Providing teachers and students with technology without providing time and opportunities for teachers to learn how to integrate these tools into their practices is unlikely to result in significant changes in instructor or assessment results. Districts that have provided time during the school day, with substitute teachers hired for regular, ongoing PD, have seen the benefit in teacher integration of technology into subject area learning. Districts providing training after school or during planning times may not realize the benefits of meaningful technology integration, since teachers must find time on their own for experimentation and adoption. An explicit focus on teacher learning provides faculty with the time and opportunity to explore the complex issues related to using technology when students have access to it ubiquitously:

> We have a full time person on staff whose only job is PD. They are focused on integration of technology in the classroom . . . who works with teachers, individually or collectively, will sit in on classrooms, model integration, etc. Having a person responsible for ongoing integration is key: You don't hand a teacher the device and don't support it; otherwise it becomes a big paper weight. (Superintendent, district C)

Funding—Initial and Sustainable

There are a variety of ways to fund 1:1 initiatives, as evidenced from the districts that participated in this study. Bond monies, while helpful for initial outlays, often cannot be used for teacher PD and, therefore, provide a portion of the overall cost of adoption. But there are dangers in using non-sustainable money to fund these types of projects, especially as the external funding (e.g., from the state or federal government) is reduced. Likewise, one-time funding represents challenges for future purchases—including replacement of hardware as well as increased infrastructure—that may result in financial challenges in the long term.

Participating districts have found innovative avenues for funding 1:1 initiatives, including parent/community contributions, donations and

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partnerships, incorporation of technology budget items in building or school expenditures, and use of federally available money (Title I or II) for targeted student populations. All the participating districts in this study shared a concern for ongoing, sustainable funding for hardware, software, and infrastructure:

> We have no plans to ask the public for more bond funding for our laptop initiative. This project can only be sustained by building the costs into our operating budget. (Assistant Superintendent, district C)

Evaluation Plan

Two of the five districts in this study had a formal evaluation plan for their technology initiative. While it may be acceptable for districts to provide anecdotal evidence of change as a result of a 1:1 initiative, others will struggle to justify stakeholders' commitment if more formal methods are not used. Districts struggle to demonstrate benefit from a technology initiative when they do not measure success.

Districts with a formal evaluation plan are more likely to gather evidence of success in implementation, develop and monitor indicators of improvement, and demonstrate benefit to their stakeholders. While three of the districts participating in this study lacked a formal evaluation plan, some indicated this as an area they hope to improve on in the future:

> We have an evaluation plan, an informal one, and we plan to conduct a formal evaluation, but it's not defined yet, but we plan to do it. (Superintendent, district B)

Focus on 21st-century Literacy Skills

Related to the potential benefits resulting from a 1:1 initiative, focusing on standardized test scores (i.e., No Child Left Behind state testing) was not generally cited by participating districts. The research literature on 1:1 initiatives suggests that student test scores may fall during the first year or two of an initiative (Grimes & Warschauer, 2008). An alternative motivation for 1:1 programs identified by study participants is related to 21st-century literacy skills. The attempt to monitor and report improvements in these "soft skills" has been shown to increase as a result of 1:1 initiatives (Warschauer, 2007). While participating districts recognized the need to measure alternatives to traditional standardized tests, they were not aware of tools and metrics to use standardized test scores in this manner.

Districts that participated in this study were exploring ways to measure success beyond standardized test scores, realizing that they may not see improvements in the short term using these measurements. Providing

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instruction and assessment in 21st-century literacy skills represents another way to gather and share evidence of the impact of a 1:1 computing initiative on students that stakeholders can agree provide benefit:

> The first thing is for students to be better prepared and have skills for the future which set them apart from other students. (Superintendent, district C)

DISCUSSION

Successful adoption and implementation of 1:1 initiatives in K–12 schools require a complex set of tasks and activities, supportive resources, as well as communication of a vision for adoption and collaboration among all stakeholders. This study provides evidence of the value of these types of initiatives when they are well funded and supported. As with any other effort to impact teaching and learning in the classroom or reform instruction, these initiatives require careful planning, allocation of sufficient resources, ongoing training and support, and monitoring of measurable outcomes to provide evidence of benefit. Several key themes or challenges identified in the research literature were reflected in the experiences of school districts that are implementing or have already successfully implemented 1:1 initiatives. These common findings are summarized as recommendations for other schools interested in undertaking 1:1 initiatives in the future.

All administrative staff should be involved, should understand, and should be fully committed to a 1:1 initiative, which has broad implications on all aspects of district planning, budgeting, assessment, curriculum, and teacher PD. District superintendents are responsible for setting the vision, but principals are particularly critical for implementing effective technology integration by teachers in a given building. Absent this shared commitment and understanding, an initiative of this scope and consequence is unlikely to succeed. Also critical to success is providing intense, sustained teacher-focused PD with opportunities for exploration, reflection, collaboration, work on authentic tasks, and engagement in hands-on, active learning. Traditional methods of PD, where teachers are provided with tool-specific training, but not with the time or opportunity to explore and learn to integrate these tools into their classroom practices, are unlikely to result in benefits for students measured by improved academic achievement.

Early and often, districts should stress to all stakeholders the impact increased access to technology can have on student learning in school and beyond. Efforts to justify a 1:1 initiative on reductions in costs for school districts are short sighted and naïve, especially given the costs of access to digital textbook resources and the focus on standards-based instruction and assessment. Long- and short-term changes in budgeting, along with a plan for the ongoing costs of a 1:1 initiative, are necessary for sustainability.

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Private and state/federal funding can help support successful implementation, but sustained long-term funding should be built into school and district operating budgets, including equipment replacement costs, training, support, and infrastructure. Development of a formal plan for evaluation with measures of evidence of success gathered and analyzed is an important ingredient in successful implementation. Such a plan should include measurable data on student learning, instruction, and long-term benefits for those involved.

While short-term assessments of student achievement, measured via standardized tests, is not likely to show improvements, identifying and measuring students' acquisition of 21st-century literacy skills are likely to be realized, even in the short term. Preparing students for competence and confidence with technology is a reasonable outcome of this type of initiative and should be seriously considered when undertaking a project of this nature.

Looking closely at five school districts that have implemented 1:1 initiatives provided some insights into district decision-making related to key themes identified in the literature. While the districts differed in many respects, their commitment to implement a ubiquitous computing initiative in a time of limited resources was both a risk and an opportunity to set themselves apart from neighboring districts. These five case studies and the review of the literature help illustrate the complexity of factors and characteristics that should be given serious consideration by other districts considering similar technology adoption efforts.

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