Focused Ubiquity: A Purposeful Approach to Providing Students with Laptops

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ABSTRACT

Laptops have been introduced into classroom across the nation as a way to improve teaching and learning. In 2007 Littleton Public Schools (LPS) introduced a focused approach to providing all students with a laptop at a significantly lower cost to the traditional ubiquitous laptop programs. The purpose of this study was to document the LPS model and measure its impact on instruction and learning. In addition, a cost analysis comparing the LPS model to other approaches at infusing laptops into classrooms was conducted. The LPS is not only cost effective, the quantitative and qualitative data collected in this study suggest that this approach to laptop infusion in the classroom positively impacts instruction and learning. One implication from this study is that school districts, when considering adopting a ubiquitous laptop program, should work to incorporate a focused curricular approach to increase the likelihood of the laptops improving instruction and learning.

Keywords

Laptops, Student achievement, Cost effective

Introduction

Since the late 1970s, people have ruminated on the significant impact technology can have on student learning. In the early 1980s, as technology began to alter the way business was conducted throughout the world, policy makers emphasized the great promise that technology held for transforming public education. An early enthusiasts felt that computers would radically alter the relationship between teacher and student and that computers would open up the world to students to allow them to access information and discover new ways for creative expression (Papert, 1980).

Research related to the use of computers in the classroom has identified a number of positive influences technology can exert on the learning process. The use of computers in the classroom, coupled with clearly stated learning objectives, results in increased student achievement (Ringstaff & Kelley, 2002). Schacter and Fagnano (1999) argued that technology in the classroom positively impacts student learning, including understanding and achievement, and increases affective attributes. According to Pitler, Hubbell, Kuhn, and Malenoski (2007), computers in the classroom create “dynamic learning environments” and bolster efforts to differentiate instruction (p. 2).

Clariana (2009) reported that 31% of surveyed superintendents were implementing some sort of ubiquitous computer program, or one-to-one computing program, that provides a computer to every student in their school districts (pp. 5-6). Technology enhances student learning and the use of ubiquitous computer efforts are on the rise, but little is known about the different one-to-one computing options available to educators. The aim of this study was to document an alternative approach to infusing computers into the classroom, measure the impact this focused approach had on both teaching and learning, and conduct a cost effectiveness analysis of the three approaches.

Literature review

The purpose of the literature review is to provide an overview of the use of technology in the learning process. The literature review is divided into four sections and these sections explore the optimal practices related to technology and student achievement.
Technology and learning

The push for change in education has opened the door to new ideas while stressing the importance of altering the way teachers teach and students learn. In a letter written to the Members of Congress in November 2010, The Secretary of Education for the United State of America, Arne Duncan, stated that:

The model for learning described in this plan calls for engaging and empowering personalized learning experiences for learners of all ages. The model stipulates that we focus what and how we teach to match what people need to know and how they learn. It calls for using state-of-the-art technology and Universal Design for Learning (UDL) concepts to enable, motivate, and inspire students to achieve, regardless of background, languages, or disabilities. It calls for ensuring that our professional educators are well connected to the content and resources, data and information, and peers and experts they need to be highly effective. And it calls for leveraging the power of technology to support continuous and lifelong learning. (p. v)

The ideas outlined in the plan entitled Transforming American Education: Learning Powered by Technology (U.S. Department of Education, 2010) highlight the need for increased college completion rates among young people in order to ensure America is able to compete in a global economy. The plan also stressed that technology is at the core of virtually every aspect of daily life and work, and must be leveraged in a way to continuously improve the education system from the time children enter academia until they complete higher level schooling and/or enter the workforce.

Part of the push for using technology in schools has come from business leaders who are vocalizing the desire for employees to have strong computer skills. Wagner (2008) identified many skills students need, including critical thinking, problem solving, mental agility, and adaptability. Employers are looking for individuals with strong research skills, strong information technology (IT) skills, and people who are able to think logically and process a lot of information in an organized manner (Rothstein, 2004, p. 151).

Students are a strong voice for expanding the use of technology in schools. For example, more than 55,000 students responded to the following open-ended question: “Today, you and your fellow students are important users of technology. In the future, you will be the inventors of new technologies. What would you like to see invented that you think will help kids learn in the future” (Chen, 2010, p. 244)? The responses were synthesized into this scenario:

Every student would use a small, handheld wireless computer that is voice-activated. The computer would offer high-speed access to a kid-friendly Internet, populated with websites that are safe, designed specifically for use by students, with no pop-up ads. Using this device, students would complete most of their in-school work and homework, as well as take online classes both at school and at home. Students would use the small computer to play mathematics-learning games and read interactive e-textbooks. In completing their schoolwork, students would work closely and routinely with an intelligent digital tutor, and tap a knowledge utility to obtain factual answers to questions they pose. (Chen, 2010, p. 244)

Students desire a technology-rich learning environment, which provides them opportunities to explore, learn, and take responsibility for their progress in school.

Approaches at utilizing technology

In an effort to further student and teacher access to technology, some school districts have embraced the idea of providing one computer to every student. Broadly speaking, one-to-one computing initiatives support the idea of increasing student access to technology in schools (Li, 2010). “It is anticipated that the impact of this kind of initiative on student learning and pedagogical practices is likely to be far more pervasive and permeable than the other large-scale information technology (IT) initiatives implemented in the past” (Li, p. 284). In fact, “One-to-one computing is one of the fastest growing yet most controversial phenomena in American classrooms” (Lei & Zhao, 2008, p. 98). Over the last decade, one-to-one projects have dramatically expanded with major initiatives taking place in at least 33 states across the country (Lei & Zhao). Some states have undertaken expensive projects to provide laptops to all secondary students. Proponents of these efforts, “believe that educationally beneficial uses of
computers will emerge spontaneously from the deployments of laptop computers in ratios of one computer per user” (Weston & Bain, 2010, p. 10). A study conducted in 2004 examined the impact of laptop computers use in schools in France concluded, “the inference drawn from the hypotheses regarding the use of portable computers in schools postulates that use of this tool should enable the development of cognitive and behavioral abilities which in turn lead to a marked improvement in pupil attainment” (Jaillet, 2004, p. 115).

Unlimited access to the Internet and the integration of technology as a tool for learning has been viewed by many as a way to transform instruction and learning in classrooms (Halverson & Smith, 2009-2010). Some advocates also feel that one-to-one technology in schools helps to minimize the extent to which differences exist between students in large and small districts and support learning for students who have access to resources and those who typically are less fortunate (Chen, 2010; Penuel, 2006). Referring again to the 2010 National Education Technology Plan, a key element of the plan is to “Ensure that every student and educator has at least one Internet access device and appropriate software and resources for research, communication, multimedia content creation, and collaboration for use in and out of school” (p. xix).

Maximizing technology

In order to prepare teachers and students for the digital-age, considerations must be made as to whether or not educators have the skill set necessary for utilizing the tools within a technology rich classroom. More often than not, when it comes to technology, teachers are learning in parallel with, or at times from, their students (Gorder, 2008). In the case of some veteran teachers, there may be a hesitation to use technology as a tool for learning due to a lack understanding. “Teachers need to know how and why to use technology in meaningful ways in the learning process for technology integration to work” (Gorder, 2008, p. 64). While access to technology in classrooms has greatly increased over the last decade, a study found that less than 32% of educators reported using technology as part of their daily classroom practices (Gillard & Bailey, 2007). Part of the problem may be due to the focus or lack of time allotted for teacher training in the area of technology. “Most of today’s educational technology training for both preservice and practicing teachers tends to focus on the mechanics of computer operation, drill and practice, and tutorial software with little integration into specific subjects” (Harwell, Gunter, Montgomery, Shelton, & West, 2001, p. 260). According to Christensen, Horn, and Johnson, (2008), “Understanding how schools have spent so much money on computers only to achieve such little gain isn’t so hard. Schools have crammed the computers into the existing teaching and classroom models” (p. 84). Christensen et al. contended that the lack of professional development to train teachers to effectively use laptops in the classroom enabled teachers to just use the computers to support their current teaching practices. In other words, without the professional development, teachers will not change their practice to accommodate the laptops, which then minimizes the impact the technological tool can have in the classroom.

In short, “If technology is to be integrated successfully into classroom instruction, teachers must be able to demonstrate successful mastery of technology use themselves” (Harwell et al., 2001, p. 260). Based on this fact, leaders in the field of education should pay close attention to teacher preparedness for the use of technology in the classroom. Ultimately, teachers’ attitudes and beliefs about technology’s role in the classroom are directly related to the amount of professional development they have received (NCES, 2000).

A review of the literature found that teachers who engage in in-depth professional development activities centered on the utilization of technology were more likely to report feeling prepared to use computers and the Internet for instruction (Penuel, 2006). Part of the process also involves changing teachers’ perceptions about the value of technology in daily instruction. “It is believed that teachers’ receptiveness to technology and a re-conceptualization of its role in teaching and learning can drive the development of new pedagogies and curricula and eventually, bring about new and meaningful learning experiences for students” (Li, 2010, p. 285). The key aspect of this shift is dependent on two variables: (1) a teacher being comfortable with the many facets of any given technology and (2) a teacher’s ability to evaluate and integrate the use of that technology into the curriculum (Keengwe, Onchwari, & Wachira, 2008).

In order to avoid frustration that can arise from technical breakdowns, teachers also value knowledgeable technical support. “In addition to professional development, readily available technical support also appears to be important for laptop programs to succeed” (Penuel, 2006, p. 339). If school districts are to find success with the use of one-to-
one computing as a tool for learning, educators must be able to move beyond teaching basic skills and use technology as a tool to enhance those skills outlined by business leaders to prepare students for the global economy (Wagner, 2008). Teacher-leaders described their vision of the future and postulated that:

Because students will have easy access to information, the education delivery systems of the future will demand intensely individualized learning. The scarcest commodity will be attention, and successful educators will be those who can attract and hold students’ interest while helping students develop the habits of mind and the digital facility they need to process and evaluate relevant information. Teachers who can customize learning experiences and facilitate them in both physical and virtual environments will be highly sought after. (Moore & Berry, 2010, p. 36)

The National Education Technology Plan (2010) supported this vision, emphasizing the importance that, “They (teachers) are connected to resources and expertise that improve their own instructional practices, continually add to their competencies and expertise, and guide them in becoming facilitators and collaborators in their students’ increasingly self-directed learning” (p. 40). Ongoing teacher training and development are vital aspects of successful technology use in the classroom environment.

Profile of school districts

The three school districts included in this study are profiled below. Basic demographic data are presented on all three school districts. The profile for Littleton Public Schools (LPS) includes a summary of the one-to-one computing program that the school district developed to focus the use of technology in the classroom on writing.

LPS

LPS is a suburban school district located in the Southeast metro area of Denver, Colorado. The school district includes 22 schools serving approximately 15,000 students. The district supports a student population in which 20.79% qualify for the Federal Free and Reduced Lunch program, with individual schools in the district ranging from a low of 4% eligibility to a high of 81%. The district has earned Colorado’s highest accreditation rating for documented high achievement and high growth indicators. LPS is the only Denver metro-area district to hold this rating and has earned it each of the three years the rating has been given by the Colorado Department of Education (2012).

The Littleton laptop initiative

The Inspired Writing initiative is a technology integration project conducted throughout LPS to connect writing instruction and one-to-one computing use in classrooms. Research conducted by the District leadership prior to the effort suggested that writing achievement could be expected to improve through the instructional use of computers in classrooms (Pitler, Flynn & Gaddy, 2004). As the Learning Services department engaged in a Literacy Initiative, the Information and Technology Services Department dedicated support to that effort with technology integration. The literacy program emphasized professional development for writing instruction using models like the Calkin’s (2003) Writer’s Workshop. Inspired Writing became the initiative to support writing instruction through the use of inexpensive netbook computers assigned to Language Arts classrooms in all schools across the District.

During the initial pilot year in 2007-2008, five elementary schools deployed netbook computer carts in fifth grade classrooms in support of the new writing initiative. An independent grant evaluator concluded that achievement gains had been realized on three different forms of student assessment (Nebelsick-Gullett, n.d.). The district expanded the Inspired Writing initiative in 2008-2009 to every fifth grade classroom and every 6th and 9th grade Language Arts section in the district. An independent review of achievement data concluded that achievement differences between grade levels that were included in the Inspired Writing initiative saw achievement gains as high as 14% on the state writing assessments. The review concluded that the combination of the curriculum, professional development, and infusion of technology produced the achievement results (Warschauer, 2011).
The current state of the Inspired Writing initiative in Littleton Public Schools has been expanded to serve all students grades 5 through 12. LPS has purchased 2,800 netbooks to support the Inspired Writing program. In addition, school-initiated efforts to expand netbook availability in the classroom have resulted in an additional 5,700 computers district-wide. The total inventory of 8,500 Linux-based netbooks compliments the 5,500 Microsoft Windows-based computers maintained in the district. The district manages a domain for Google Apps for Education in which students across the district produced over 200,000 Google Docs during the 2011-2012 school year and over 180,000 documents during the fall semester of 2012-2013. The methodology of the initiative was documented and compared to other national examples as a model program in Warschauer’s (2011) Learning in the Cloud.

The one-to-one mac school district

The school district utilizing a traditional one-to-one laptop program reports 39% of its students qualify for the Free and Reduced Lunch Program and its minority students total 48% of the total student population. This school district entered into a contractual agreement with Apple Computers to provide all of its high school students with laptops. The program was rolled out incrementally, beginning with just the incoming freshman during the 2008-2009 school year and adding a class each year. Due to the fact that Colorado is a school of choice state, the principle purpose behind the infusion program in this school district was to recruit students from neighboring school districts. This school district is relatively small and the infusion effort has resulted in an annual increase in student enrollment by roughly 5%.

The non-infusion school district

The non-infusion school district is one of Colorado’s largest school district with an enrollment of more than 28,000 students. There are over 50 school sites. The district has a diverse population with the largest ethnic groups being 66% White and 28% Hispanic. Student access to technology varies greatly from school to school in this school district. Funding for technology has been provided by the district technology department and from parent/teacher organizations. The majority of technology funding has gone into infrastructure such as projectors, document cameras, and computer labs in schools. As of the 2012-2013 school year, there was not a plan to provide additional student access to laptops or netbooks in a unified manner.

Research questions

Given the unique nature of the LPS laptop infusion program, the researchers posed three questions they wanted to answer to better understand this focused ubiquitous effort. The three research questions are listed below:

- How has the Littleton Public Schools (LPS) model for infusing technology into the classroom influenced learning?
- How has the LPS model influenced teaching?
- How cost effective is the LPS model?

Conclusions

There is a high degree of consensus related to the use of technology to enhance the learning experiences of students in the 21st Century. The question is how school districts can most effectively introduce a one-to-one computing program into classrooms to provide all students with a technologically enriched learning opportunity? The data collected in this study help to gauge the effectiveness of two different approaches at infusing this technology into the classroom.

Methodology

The three research questions each required a specific methodology to ensure the validity of the findings. However, the overall design, population, and data collection instruments are described first. Then the methodology used for each research question is described.
Design

Creswell (2012) stated, “you conduct a mixed methods study when you have both quantitative and qualitative data and both types of data, together, provide a better understanding of your research problem than either type by itself” (p. 535). The researchers selected the mixed methods design for this study to better document the impact the LPS laptop infusion program is having on instruction and learning. To rely exclusively on one type of data would have resulted in a less than thorough analysis of the LPS laptop infusion model.

Population

The population for most of this study consisted of the LPS teachers and students in grades 5 through 12 language arts classrooms. The data collected from this first population produced the answers to research questions one and two. The population for the third research question included three school districts.

Data collection instruments

There was a total of four data collection instruments used in this study. The first data source was interviews with LPS language arts teachers, grades 5 through 12. The second data source came from focus group discussions with LPS students enrolled in language arts classes, grades 5 through 12. The third data collection instrument was a quantitative classroom observation tool that objectively documented the number of pedagogical traits observed in language arts classrooms at specific time intervals. The final data collection instrument was the cost analysis formula.

Research question #1

For the first research question, teacher and student interview questions were created in order to evaluate the effects of technology on learning. In terms of teachers, the questions were focused on lesson objectives and the integration of technology as a tool for writing instruction. During the initial pre-conference interview with teachers, questions were intended to explore the amount of professional development they received related to netbook integration, their views on technology as a tool for learning, and whether or not teachers felt that netbook technology had altered the writing process for their students.

Student interviews were focused on the way students felt their writing had or had not changed as a result of the use of netbook computers in the classroom. Student interviews took place about half way through the school year after students had been given ample time to use netbooks during writing periods and were held in a focus group format during the school day. There was value in having students interact with one another as they related their collective experiences with the use of technology in the classroom environment. Both teacher and student interviews were conducted in a semi-structured manner with key questions and sub-questions based on participant responses.

Research question #2

In order to answer the second research question, an observation tool was created with the intent of recording interactions that took place in a one-to-one computing rich classroom. The observation tool was based on partial interval recording with data being collected every five minutes during a 40-minute period. Individual indicators were checked if 80% of the class exhibited the behavior during each five-minute interval.

On the observation tool, the indicators are separated into three areas: (1) Use of Technology, (2) Content, and (3) Pedagogy. The Use of Technology section has six observable indicators, with eight periods of observation, for a total score of 48. The Content section has three observable indicators, with eight periods of observation, for a total score of 24. Finally, the Pedagogy section has four observable indicators, with eight periods of observation, for a total score of 32 (the observation tool is available upon request).
The standard utilized from the North Carolina teacher evaluation tool, labeled *Teachers Facilitate Learning for Their Students*, which served as a second data point, has eight indicators based on a four-point scale for a total overall score of 32 (McREL, 2009). Data were collected for this tool during the 40-minute observation period and scored when a behavior was observed. Evidence supporting each of the eight indicators was recorded based on student/teacher interactions on a separate sheet as a way to collect additional data resulting in final scores on the North Carolina scale.

After each classroom observation, the total score for the three sections on the observation tool were compared to the overall score on the North Carolina scale. In order to analyze the data, a bivariate correlation was conducted. This analysis determined whether or not the three independent variable, 1) effective use of technology, 2) strong writing content, and 3) sound pedagogy, had a positive or negative relationship with the dependent variable identified on the North Carolina scale, that of teacher effectiveness in the classroom setting. The data was also triangulated for trustworthiness through the use of observations, interview and focus groups, and by conducting member checks with the interview data collected.

**Research question #3**

A formula was developed to quantify the cost effectiveness of the different laptop infusion programs detailed in this study. The formula had to control for the size of the school district since the three districts in this study vary in student population. The formula divided the cost of the infusion program by the number of students served by the infusion program to generate a per pupil expenditure figure:

\[
\frac{\text{Cost of Infusion Program}}{\text{Students Served}} = \text{Infusion Program Per Pupil Expenditure.}
\]

The formula was applied to the data from all three districts for the last three years to measure the trends related to the per pupil expenditure of each infusion program.

**Findings**

The findings presented in this section are structured around the three research questions. These findings will determine the influence the LPS one-to-one computing program had on learning and teaching. In addition, the cost analysis findings are presented to measure the fiscal impact of each approach to infusing computers into the classroom.

**Findings: Student learning**

Based on the teacher and student interviews, certain themes emerged largely in favor of the use of netbooks for writing. An analysis of the data encapsulated through the coding process identified five themes. The first theme was focused on technology supporting a student’s ability to revise and edit their work. Teachers talked about the ease of revision specific to the writing process, which is often a roadblock for many reluctant writers. Students discussed how the use of netbooks allowed them to change their work with very little effort. For many teachers, the efficiencies related to the editing process also appeared to free students up to write more and to take risks with their writing that they may not have done with a handwritten product.

The second theme highlighted the importance of professional development for teachers and the need for quick and effective support. In this case, teachers highlighted the extensive training they received regarding the use of netbooks for writing instruction. LPS had a unique approach to professional development in that they provided a lot of guidance to teachers initially through required trainings and then provided ongoing support to teachers throughout the school year. In addition to their initial training, teachers were given opportunities to participate in classes and to share ideas with one another during the school year. This open dialogue helped teachers to take risks and make mistakes, which are key components of the learning process. Teachers also discussed the value in having technology support within their school building. Quick support appeared to minimize teacher frustration and prevent teachers from giving up on the netbooks altogether.
Differentiation was another key component that surfaced through the teacher and student interviews. Students talked about accessing information quickly in a way that enhanced the learning process. A key finding in this area related to students becoming less dependent on the teacher and more self-directed with their learning. In fact, some students made direct comments about how they were beginning to rely less on their teacher to complete their work. One student stated: “Like if you forgot the directions, you can just look back at them (in Google Docs), like the kids don’t have to go ask the teachers for the directions again.” Students who were less dependent on their teacher also talked about being more engaged in the learning process. One student talked about engagement this way:

I’m more interested because I’m a lot better at computers than just watching a teacher because watching the teacher for like 15 and 20 minutes makes me really bored because she’s just going “blah, blah, blah, blah, blah”...and when we do our netbooks, we’re not just watching our teacher...but we’re actually doing stuff.

While engagement is a difficult concept to quantify, self-directed learning, according to the students who were interviewed, did in fact help them be more engaged in what was going on in class.

Teachers mirrored student comments in terms of the way netbook use helped them to differentiate instruction for their students. During some of the interviews, teachers talked about work with students, which allowed them to guide individuals through the learning process rather than just being in front of the class teaching. According to one teacher, “I mean if you’ve bought a kid a new toy…and for two weeks it’s the greatest thing on earth and then nothing, you know. And it would be the same thing with the netbooks if you just dropped them into a room. It has to change the way you teach and that’s what makes the engagement.” In these instances, the teacher’s role had changed from “sage on the stage,” as one teacher put it, to a true facilitator of learning. This finding was supported through the observation process as well. Those teachers who were rated as being most effective on the observation tool spent little time teaching in a traditional manner. Instead, they provided quick instructions to the class, which allowed students to access information pertinent to the lesson on their netbooks. The teachers then moved around the room to support students individually, which is a key aspect of differentiated instruction. Similarly, an analysis of the interview data indicated that teachers needed to give up some control in the traditional teaching and learning process. Teachers who were willing to take risks and struggle right along with their students experienced success and even looked to students to help guide instruction. Empowering students appears to lead to increased student engagement throughout the learning process.

Another prominent theme that emerged was the increased ability for teacher to student and peer-to-peer feedback in the area of writing. By posting student writing in an electronic manner, both teachers and students were able to view written work and give comments to one another to make their writing better. For teachers, this type of feedback allowed them to interact with students more frequently and freed them up to make multiple comments that a student could view and follow up on later. This was in direct contrast to a traditional writing conference where students might confer with a teacher and then go back to their desk to write. The main points of the conference in this more traditional format are often lost or forgotten. Students also appeared to be very comfortable looking at each other’s work when netbooks were in use and providing meaningful feedback on what was written. This additional feedback meant that several people were looking at what had been produced in addition to the classroom teacher.

Finally, technology provided an expanded audience for student writing. Teachers talked about sharing student writing electronically with parents, grandparents and other adults. This expanded audience helped students to realize that what they were writing was public and was being viewed by many individuals at any given time. Teachers commented on how this expanded audience helped students to put more effort into what they were writing. Wikis and blogs were used in many of the classrooms as a format for students to share their work with others.

Findings: Teaching

In addition to the teacher and student interviews, data collected from the use of the observation tool helped to answer the research question focused on student engagement when technology was in use in classrooms as a tool for learning. The findings from the 18 classroom observations indicated that students were more engaged in the learning process when teachers utilized technology in a successful manner. That is, teachers who scored the highest on the North Carolina scale, intended to gauge a teacher’s ability to facilitate learning in the classroom, tended to use netbook technology to teach writing in a more effective manner than those teachers who scored lower on the North Carolina scale.
Carolina scale. This finding suggests that the need for integration of pedagogy and technology is valuable in enhancing student learning.

Effective and efficient use of netbooks as a tool for writing also resulted in increased student engagement as measured through higher scores on the observation tool in terms of a teacher’s ability to use technology while also providing strong content and pedagogy for students. Furthermore, netbook use for the highest rated teachers resulted in an enhanced written product. To put it simply, student work was enhanced by the effective use of technology in the classroom. This is an important finding and suggests that students can become better writers when netbooks are in use and that technology, when used effectively, may be more than just another glorified tool for writing in schools.

Findings: Cost effectiveness

Despite the fact that the LPS infusion model positively impacts student achievement and teaching, the focus of the third research question is on the cost effectiveness of the different approaches to infusing laptops into the classroom. Table 1 summarizes the per pupil expenditures for each of the three school districts included in this study.

<table>
<thead>
<tr>
<th>School Year</th>
<th>Cost (Littleton Public Schools)</th>
<th>Cost (One-to-one computing Mac School District)</th>
<th>Cost (No Infusion School District)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-2010</td>
<td>$282,000</td>
<td>$155,897</td>
<td>$0</td>
</tr>
<tr>
<td>Students Served</td>
<td>2,785</td>
<td>189</td>
<td>0</td>
</tr>
<tr>
<td>PPE Infusion</td>
<td>$101.26</td>
<td>$824.85</td>
<td>$0.00</td>
</tr>
<tr>
<td>2010-2011</td>
<td>Cost (Littleton Public Schools)</td>
<td>$274,000</td>
<td>$0</td>
</tr>
<tr>
<td>Students Served</td>
<td>2,963</td>
<td>375</td>
<td>0</td>
</tr>
<tr>
<td>PPE Infusion</td>
<td>$92.47</td>
<td>$404.90</td>
<td>$0.00</td>
</tr>
<tr>
<td>2011-2012</td>
<td>Cost (Littleton Public Schools)</td>
<td>$315,000</td>
<td>$0</td>
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<td>Students Served</td>
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<td>548</td>
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<tr>
<td>PPE Infusion</td>
<td>$77.99</td>
<td>$260.62</td>
<td>$0.00</td>
</tr>
</tbody>
</table>

The cost of the two computer laptop infusion efforts decreased as more students benefitted from the efforts. However, using the PPE Infusion formula, which divided the cost of the infusion effort by the number of students being served, it is clear to see that the LPS model is more cost effective than the more traditional infusion effort. The cost effectiveness of the LPS model is accentuated by the fact that its most expensive PPE Infusion, $101.26 per student, was still only 39% of the lowest PPE Infusion cost for the traditional infusion model.

Implications

There are several implications that can be drawn from the analysis of these data and assimilated for teachers, students, and principals. First and foremost, classroom teachers need to understand that they can, in fact, have a positive impact on the way students write when using netbook technology in the classroom setting. The results of this study indicate that effective teachers can use netbooks to differentiate instruction for students and expand the scope of individuals providing feedback to students about their writing. The data also suggest that teachers should take risks and experiment with the various tools available to them including wikis, blogs, and Google Docs to provide templates and guidelines for students that allow them to become more self-directed and responsible for their learning. In addition, teachers who embrace the use of netbooks for writing need to re-examine how they teach. The data indicate that the most effective teachers in this study have begun to shift away from the traditional teaching model – that of presenting information to a group of students from the front of the class with limited interaction or opportunities for feedback. Instead, these teachers are presenting material in a way that requires very little direct instruction so that students know where to go and what to do, which in turn frees up a teacher to conference individually with more students or even coach students on how to provide meaningful feedback to one another.

The students who took part in this study appeared to have increased confidence as writers when netbooks were in use. They talked about being more self-directed and also about the value of interacting with a variety of individuals,
including their classroom teacher, throughout the writing process. One student said, “I think that the netbooks are good because it’s easier to get feedback from teachers and from one another on our blogs that we make for reading.” Another student said, “It definitely helps because if you want to check someone else’s work, all they have to do is share it with you so that you can make sure that their work is good just like yours is.” Obviously these students had the benefit of hands on instruction as to the proper and effective use of netbook technology, but it was impressive to witness firsthand how competent 5th grade students had become after only a few months of using netbooks in the classroom. Day-to-day access to this technology in conjunction with a teacher dedicated to netbook use appeared to be a key aspect of some students’ success as well, which is an argument in favor of the one-to-one model. For the classrooms that were observed, the transition from a reading or math lesson to a writing lesson contingent on netbook use was seamless and part of the daily routine for students.

Another important implication is that students, much like teachers, need to have the opportunities to make mistakes and take risks when technology is in use. During classroom observations, a number of students were seen interacting with one another through electronic means, asking for help, or attempting to try out a new procedure or process. The teachers in this study stressed that students learned best through trial and error and when given the opportunity to experiment they frequently experienced growth as writers.

Finally there are various implications for principals and other school leaders when consideration is given to netbook use in schools. A key point involves the scope of professional development provided to teachers. In this study, teachers talked a lot about the benefit of on-going professional development as well as the opportunity for quick and efficient technical support. Teachers who received training focused on the use of netbooks and the use of technology tools related to writing appeared to have a positive attitude about the various ways this type of technology could be used in the classroom. This is in direct contrast to some one-to-one programs where teachers are given a netbook or laptop with very little instruction or support and basically encouraged to figure it out on their own.

School principals and leaders should also take the time to obtain feedback from teachers on how netbook technology is working as a tool for learning. Principals simply cannot assume that technology will make a positive impact on the way students learn. If a principal knows how netbooks are being used, effectively or ineffectively, support can be provided to increase a teacher’s capacity to positively impact student performance in writing and in other subject areas as well.

Conclusions

Based on the findings detailed in this study, the LPS Inspired Writing infusion effort is a model that other school districts should replicate. The data reported here demonstrate that the Inspired Writing program positively impacts writing and teaching. In addition, the LPS model has been shown to be more cost effective than providing the more traditional ubiquitous laptop programs. The title of this study purposefully includes the phrase “focused ubiquity.” The LPS laptop infusion program is commendable for its focused approach to positively influence student achievement. Instead of just providing students with laptops and all teachers with some professional development, LPS educational leaders decided to focus the potential impact of laptops in the classroom on improving writing skills and, as a result, focused all professional development on how language arts teachers could best utilize this technology. The ubiquitous nature of the LPS model lies in the fact that the laptops are made available to all students in their language arts classes. Realizing that all school districts operate on a limited budget, any infusion effort that produces the results reported in this study at a fraction of the cost of a traditional laptop infusion effort is worthy of emulation.

References
