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Berkshire Wireless Learning Initiative Final Evaluation Report

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Discussion

In school, it is important to keep kids informed and ready for the real world and the work force, and computers are becoming a very important part of our world. It is important that we know how to use a computer so that when we reach the workforce and higher levels of education, we are not struggling to keep up. Also, using computers in school is a great way to keep kids focused and ready to learn, and keep people interested in the education they are receiving. computers, especially laptops, are our links to an ever-expanding world of technology, and it is important to know how to connect to this world easily, which having laptops allows us to do.

8th grade Female Student

Herberg Middle School, Pittsfield, MA

Comment on June 2008 student survey

As educational theorist and critic Larry Cuban and others have demonstrated, educational technology use in typical school environments (where technology resources are shared) has typically resulted in sporadic and limited use, particularly when considering teachers' direct instructional use and students use (Cuban, 2001). Given that there has been historically sporadic and little use of technology in education, the impacts of various technologies in education have been slow to emerge. One of the earliest findings emerging from the pioneering 1:1 settings (the first 1:1 student laptop program was launched in 1989 in Sydney Australia) was that student and teachers use of technology increased exponentially. This dramatic increase in computer use is obviously related to the increased access and resources when technology is no longer shared, as well as the leadership and vision of these early adopting educational settings. However, with technology actually being used with some regularity it is possible to begin to realistically assess how different uses may impact teaching and learning.

The purpose of the BWLI program and this subsequent evaluation has been to determine the impacts of a 1:1 pilot program on reforming teaching and learning practices across five varied middle school settings. Although the implementation and outcomes across each participating school varied, it is clear from the current investigation that 1:1 computing holds major promise for impacting the lives of teachers and students in meaningful ways, which may lead to many positive outcomes. Specifically, the current investigation was principally concerned with documenting the four targeted program objectives identified before the pilot program was launched in 2005: enhanced student achievement, improved student engagement, fundamental shifts in teaching practices, and enhanced student research and collaboration. Of specific interest within our study has been the way teachers transformed their teaching practices to accommodate technology and how these changes enhanced student engagement and learning. Within this context, the various methodological approaches and subsequent statistical results reveal that teaching and learning were indeed impacted across the vast majority of BWLI classrooms, as reported in this report's *Findings* section. However, as would be expected from any pilot program employed across dozens of classrooms in five unique middle school environments, the degree of adoption, use, and subsequent realization of positive outcomes varied across and within settings.

As summarized in the *Introduction* and *Background* sections of this report, past research and evaluation on the impacts of 1:1 computing have generally focused on similar academic outcomes. However, given that 1:1 computing is still in its infancy and that few of the largest programs have had serious resources invested in evaluation and research efforts, there is still a great deal to learn about 1:1 laptop computing programs. Like studies in New Hampshire (Bebell, 2005) and Maine (Silvernail, 2008), the Massachusetts results from the BWLI program suggest that 1:1 computing can dramatically and radically change teaching and learning practices. There is little question that the student and teacher laptops, in addition to the increased professional development, support, and organizational structure provided through the Berkshire Wireless Learning Initiative, vastly changed teaching and learning conditions for the majority of students and teachers in these settings. Specifically, after three years of implementation we witnessed a marked change in teaching and learning in the participating schools. The consensus of the participants (school leaders, teachers, and students) was overwhelmingly positive towards these educational opportunities afforded through increased educational technology. As observed years earlier in the New Hampshire pilot program, it was very soon in the deployment process that teachers and students began incorporating technology into their lessons. This suggests that 1) teachers and students felt ready for change and 2) the majority viewed educational technology as an improvement over existing practices.

The proponents of educational technology and 1:1 programs believe there is potential to radically change the teaching and learning practices and even classroom structure via the adoption and use of 1:1 computing, much the same way other areas of our culture (communication, entertainment, etc) have been transformed through PCs, e-commerce, and the Internet. Indeed, many of the early visionaries of the 1:1 computing "movement" have pointed to outcomes and results that go well beyond the scope of most educational initiatives. Maine Governor Angus King, who is credited with launching the first statewide 1:1 laptop program, for example, promoted the *Maine Learning Technology Initiative* as an important component of Maine's economic development initiative. Edu-

cational theorist and author Seymour Papert argued over 30 years ago that providing students with powerful technologies could and will change the nature of how students think and retain information. Similarly, today's students, as evidenced by their frequency of home computer use and through other regional and national appraisals, have quickly embraced computer technologies across all aspects of their lives. Indeed, students' expectations for computers and their seemingly natural abilities to assimilate technology are so great that it can even be disconcerting to teachers and parents. For example, the explosion in popularity of websites such as Facebook and mySpace for social networking and communication amongst middle and high school students cannot be exaggerated. Although the targeted objectives assessed in the BWLI program were somewhat more conservative by nature, 1:1 computing, given its ubiquitous nature and the ever-increasing power and adaptation of computing technologies, continues to represent a strong departure from the status quo and existing educational practices in most public middle schools. As documented specifically in the detailed analyses of student and teacher practices and attitudes across the five BWLI settings, not every teacher was willing or interested to experience a "radical shift" in their pedagogy and practices as the majority of their students seemed to be.

It is impossible to overstate the power of individual teachers in the success or failure of 1:1 computing. As discussed at greater length in the *Results* section on classroom observations, it is critically important to appreciate the pivotal role that classroom teachers play in the success of 1:1 computing. Looking across all of the current data, it is clear that teachers nearly always control how and when students access and use technology during the school day. In addition, teachers must make a massive investment in time and effort to adapt their teaching materials and practices to make the 1:1 environment effective and relevant. With the adoption of the BWLI program, teachers were asked to change their existing practices and integrate technology across all aspects of their professional lives. As such, these results suggest that the burden of change is often greater for teachers than for any other participants in a 1:1 initiative.

In each of the 1:1 settings, there remained a small number of teachers who were reluctant to change their "tried and true" pre-1:1 teaching practices. In a few of these instances, school principals inferred that the BWLI program may have even led a few veteran teachers to decide to retire a little earlier than they had originally scheduled. However, the potential changes in pedagogical approach and resources afforded by 1:1 computing also served to attract and excite both existing and incoming teachers. In nearly every BWLI middle school, principals expressed pleasure at the excitement of incoming teacher applicants, many of whom commented specifically in their applications and job interviews that they were especially attracted to the school for its 1:1 program. Although the emphasis in the current study was not to determine how and why the majority of teachers exhibited enthusiasm for 1:1 computing while others were decidedly less inclined, some further discussion may be illuminating.

Despite widespread increases in teachers and student technology use, across the three years of the formal program implementation in the five participating 1:1 schools, there was no single subject area or grade level where technology uses were found to be universally more widespread or universally unused. In other words, no single subject area received universal high or low use across more than a couple of schools. Similarly, although BWLI students generally reported using computers to

“find information on the Internet”, “take notes in class” and “access a teacher’s website” as among the most frequently occurring student uses in each setting, notable differences were also observed across the patterns of student computer use in each of the individual BWLI settings. Furthermore, throughout a school day, a student during the second or third year of the program could easily go through the day without ever using their laptop if none of their teachers had a “laptop lesson” prepared. Similarly, a student in different classes with different teachers could use their laptop throughout the day within the same grade level and school setting. Taken collectively, we can conclude that it was factors *within* each school setting which played a larger role in the adoption and use of technology than factors related to trends across subject areas or grade level. Survey data, as well as the qualitative data collected in these 1:1 schools, suggest that teachers’ adoption of technology is related to a number of factors. These factors include teachers’ beliefs and attitudes about pedagogy and the value of educational technology, ease of access to technology, quality and timeliness of technology support, professional development and training, as well as a school culture and leadership that values and promotes technology.

In research going back decades, it has been shown that teachers’ pedagogical philosophy and beliefs towards educational technology can strongly shape how likely teachers will be to adopt and use technology for different purposes in school (Bebell, Russell, & O’Dwyer, 2004; Russell, Bebell, O’Dwyer, & O’Connor, 2003; Ravitz, Wong, & Becker, 1999). In every BWLI school there was a wide range of staff with varied beliefs and experiences concerning education technology. Again, it was suggested that some teachers reported to be very hesitant in changing what they regarded as their own time-tested and effective educational practices. However, just as we have witnessed in popular culture over the past decade, the overwhelming sentiment towards the new technology was one of general acceptance and optimism. Again, as both the classroom observations and teacher survey data show, BWLI teachers were very quick to begin making use of their BWLI laptops for a number of educational aims and purposes. Even before the student deployment had officially begun, the vast majority of BWLI teachers had already incorporated a wide variety of regularly occurring new technology applications. The most frequent of these uses included preparing and researching lesson plans using the Internet and other computer-based resources. Teachers widely commented that they had suddenly and infinitely expanded their available curricular materials and teaching resources. Use of the new computers for communication also grew rapidly as teachers used email both with leadership and other staff within their schools but also with students and parents. Many teachers also developed web sites for their classes, which typically served as repositories for student resources and digital curricular materials as well as organization and project based managerial sources for their classes.

Across most applications of technology, it was those teachers who adopted new uses for computers (particularly for direct instructional use), who also reported the most comfort and ability to use technology. In other words, across BWLI settings, it was those teachers who adopted and frequently used technology for various aspects of their teaching who more highly rated the value of technology than those teachers who used technology with less frequency. Thus, if teachers do not value technology first and therefore make fewer attempts to use it, they may never realize the educational benefits that those teachers who more frequently use technology consistently cite. These cyclical results

perhaps suggest that increased use of technology by teachers led to teachers increased valuations for technology while teachers who valued technology less, used it less, and therefore observed fewer positive outcomes. Hence, the importance of professional development and support, both of which teachers reported were most beneficial when the focus was shared between technology mechanics (i.e. learning new applications, software) and the integration of meaningful technology into to the curriculum.

There is also a fairly common assumption in education that new generations of teachers will promote and master the use of educational technology in the classroom given their personal exposure to technology while growing up. Research from non-1:1 settings as well as observations across the BWLI settings, suggests this assumption is only partially true. It was observed that in general the younger generation of teachers most quickly adopted and applied technology resources to support their teaching with widespread use of computers to research lesson plans and communicate with professional peers. However, teachers' age was largely unrelated to use of technology for instructional purposes and with students in class, and found that newly hired teachers often took a few years of acclimation before they were regularly using technology as an instructional tool and with their students. Again, these results also underscore the myriad ways that teachers have applied and used technology to support teaching and learning in 1:1 settings.

Teachers' access to technology resources also varied across the BWLI settings in ways that likely impacted the frequency of teacher and student use as well as the program outcomes across the different settings. Although all students and teachers were provided laptop computers and wireless learning environments, access to peripheral and supporting resources varied greatly across the three years of the project deployment and across the five school settings. The results suggest that in some cases, 1:1 student and teacher laptops were not always entirely adequate or sufficient for meeting the hardware and software needs of each teacher. For example, despite 1:1 student laptops, teachers noted obstacles when LCD projectors were not easily available to them. Another example detailed in the *classroom observation results* section was a lack of printers available in some BWLI schools. The point of such examples is that even when student and teacher computers were universally provided, there were numerous examples when technology resources and equity issues still became obstacles in successfully transforming teaching and learning practices. Clearly, to those designing and managing 1:1 initiatives there are many considerations beyond teacher and student computers, which may impact the efficacy and outcomes of the program.

As the BWLI program was implemented in five varied different middle school environments, it is possible to consider the impacts of these differences on how the program was implemented as well as what outcomes were generated. Although the purpose and research design of this evaluation do not allow for a definitive exploration of what factors were critical to the success of 1:1 computing, however a number of naturally occurring differences across participating schools deserve greater scrutiny and attention. For example, school and district leadership led to differences in how the program was managed which seemed to then impact use and outcomes. For example, in one school, after the second year of implementation other priorities and obligations left the school basically without any clear leadership concerning the management and oversight of the BWLI program at their school. From a research perspective, it is worth noting that this was also the same school were

the use of teacher and student technology use was often lowest in the student and teacher surveys, underscoring the potential link between school-level leadership and program outcomes.

As another example of differences across the three-year implementation period and across the participating schools, the percent of students who could take home their BWLI laptops varied considerably. Again, since the current research did not apply a randomized experimental design to determine the impacts of such differences, it is impossible to make causal connections between implementation differences and outcomes. However, based on the research carried out herein, 1:1 programs are clearly not always a simple and straightforward operation, but those schools that witnessed the highest degrees of implementation also seemed to be those schools with the most engaged leadership and project management.

In addition, it is impossible to determine how much of the positive educational outcomes realized in the BWLI settings would generalize to other schools who may adopt similar programs. As both past and current research has demonstrated, there is growing evidence that 1:1 computing has the potential to radically change teaching and learning practices. Even though nearly all classroom settings resulted in the variety and frequency of technology use increasing dramatically from pre-program levels, deeper changes in teaching and learning were not always universal. In the current investigation, the revolutionary rhetoric of the radical changes in teaching and learning that are possible in a 1:1 environment were largely isolated in individual classrooms and could often be attributed to the philosophy and investment by specific classroom teachers, as well as the increased technology resources.

Furthermore, it is also challenging to ascertain how the impacts of the BWLI program and 1:1 computing will be sustained following the three year study period investigated here. For example, it is possible there was some degree of “Hawthorne effect” where students and teachers made more use of technology because they were in a pilot study. Similarly, the novelty of computers in school may have led to their early use adoption and use that may not be sustained once these resources are more commonplace. Based on the student and teacher survey results most uses of technology in school peaked during the second year of the program implementation, with some small decreases reported in the third year. Conversely, it is also possible that as teachers and students grow increasingly comfortable with education technology, future use and applications will increase. As the program continued into its second and third year, the educational and professional benefits of the program were often more readily recognized by the participating teachers and staff. In both teacher surveys and principal interviews, the majority of faculty and leadership stated that the impacts of 1:1 computing may take many years to be realized. Again, given the research design and emphasis of the current study, neither of these claims can be definitively proven or disproven.

As is the case with nearly all research of interesting and evolving educational initiatives, perhaps as many questions are raised by the current examination as are answered. In describing his early enchantment and rich educational experiences resulting from his discovery of gears and transmissions at age two, educational theorist and mathematician Seymour Papert warns of the challenge (or impossibility) of addressing and quantifying the potential educational effects and impacts of providing children with rich learning environments and tools. In the Preface to the seminal *Mindstorms*,

Papert writes: “If any ‘scientific’ educational psychologist had tried to “measure” the effects of this encounter, he would probably have failed. It had profound consequences but, I conjecture, only many years later. A ‘pre- and post-’ test at age two would have missed them.” (Papert, 1993, p. xx) In many ways, the impacts of the rich learning environments afforded by the BWLI program are equally hard to consider and quantify, especially such a short time after the program was started.

It is especially important to remember when considering these results that the current study and analysis is not without its own limitations. Given the exemplary participation rates for each year of data collection, the emphasis of the current investigation relies upon quantitative data collection techniques (student surveys, teacher surveys, student achievement analyses) whereby it is possible to determine how representative or widespread any finding or result may be across all participants. The site visit data summarized in the current paper (classroom observations, teacher interviews and principal/school leadership interviews) does not provide much indication as to how widespread or universal the observations or the sentiments expressed in the interviews may actually be across all the BWLI classrooms and schools. Thus, to maximize the validity of the evaluation results, multiple data sources were employed to address each of the targeted learning outcomes in the *Findings* section of this report.

Throughout this report, every effort was made to present the data in a succinct yet transparent manner, while providing as much formative data as possible to BWLI and school leadership. The analyses presented in the paper represent only a fraction of the statistical iterations that were performed in exploratory analyses. It should be fairly clear based on the data presented in this paper that summarizing the student survey results is a complex task given that each of the three grade levels had different laptop implementation schedules. In addition, although each of the BWLI schools was provided similar resources through the BWLI program, each school had distinct characteristics in its technology resources, policies, support, and implementation, which is why results are often presented at the individual school level.

The response rates from the BWLI teacher and student surveys were generally excellent allowing us to place more confidence in the assertion that the data presented herein adequately and properly represents the use and beliefs of the BWLI students and teaching staff. However, when considering the “final” Year 3 results, it is also important to remember that responding students in June 2008 had been in a 1:1 setting for only two years or less. Similarly, it is important to consider that for the majority of the teacher respondents, the final June 2008 teacher survey was completed after less than two years of participation in 1:1 student computing. Only 7th grade teachers had more than two years of 1:1 experience when the final rounds of the survey were collected. As such, it is important to remember that many of the teacher survey respondents may be drawing only on their initial experiences when addressing these issues. However, given that BWLI teachers are in one of best positions to observe the effects of the program, they are equally one of the best sources of information for investigating its impact and current data provides an excellent examination of teachers’ beliefs and experiences in newly developed 1:1 settings.

As the opening quote in the *Introduction* by Seymour Papert warns, the long term impacts and effects of providing students with new learning tools and environments can be extremely dif-

difficult or impossible to quantify. Given the thirty-six month evaluation timeline, only the immediate and short-term outcomes of the program can be addressed to suggest the possibility of the long-term impacts of providing teachers and students with technology resources. These long-term effects, however, cannot be understood without the quantification and documentation of technology use in the short term. Again, before any of the proposed benefits of an educational technology can be explored, the research team must be able to document if technology use is actually occurring. While there is a strong desire to examine the impact of technology on student achievement, research suggests that the impacts on learning must first be placed in the context of teacher and student technology use (Bebell, Russell, & O'Dwyer, 2004). However, through the current pre/post comparison study of teaching and learning practices across BWLI schools, it is possible to begin to frame the potential long term impacts resulting for teachers and students from increased exposure to computer-based technologies.

Again, as the quote that begins the *Introduction* of this paper suggests, one of the great challenges facing educators and policy makers with educational technology is the rapid pace at which technology resources are constantly evolving. For example, the cutting edge Apple iBooks provided to all students and teachers at the beginning of the BWLI program, were showing the limitations of their age and amount of use by the second year of the program. Particularly for those teachers who became heavily invested in using their computer, the limitations of memory, hardware, and software were realized. In short, technology resources often have a particularly short shelf life compared to traditional educational resources. If the BWLI program was replicated at the time of this report (Spring 2009), project and school leadership would likely be investigating technologies that were largely unheard of even four years ago, such as cloud networking, interactive white boards, and web-based productivity software and resources such as google docs. Further, national rhetoric since Barack Obama's election in November 2008 suggests a growing degree of federal interest and support for investments in educational technology resources while the One Laptop Per Child (OLPC) Foundation has created considerable international attention for low energy, low cost student laptops as an educational and economic reform in some of the world's emerging economies. Finally, we would be remiss to not mention that the increasing majority of students themselves in recent years have quickly adopted and widely employ technology across all aspects of their personal lives, from cell phones which increasingly contain computer functions, to the emerging ways students are using Internet resources for communication, recreation, and entertainment. This increasing gap between students and educators has led some to adopt the term "digital native" to describe just how differently today's students relate, think, and apply technology to their world than those of prior generations who were not raised in a computer age (Prenkys, 2006).

For most participants and close observers of the initiative, the general observation has been that the program has had far many reaching and positive educational impacts, but not all of these impacts were realized universally across all participants and schools. As such, the results of this program do not address the actual potential of 1:1 computing as much as they speak to one specific implementation of a 1:1 program in five varied middle school settings. In other words, the study results should not be viewed as a definitive assessment of 1:1 computing and educational technology,

but an example of the potential of 1:1 computing as implemented through a program that brought 1:1 resources into five middle school settings from 2005 to 2008.

In conclusion, the current study found many positive educational impacts resulting from participation in 1:1 computing and the BWLI program. From these results, it is easy to conclude that the potential of 1:1 student and teacher computing holds major promises for transforming teaching and learning, although there are many clear and notable obstacles. It is also challenging to predict how technology itself will change in the future and how the educational needs of increasingly tech-savvy students will be met by future educators.