Volume 11, Number 3: July 2010
ISSN: 1535-0975

Evaluating Teacher Readiness for the Implementation of One-to-One Computing Based on National Educational Technology Standards

Kevin Oliver
Assistant Professor and Program Coordinator
Instructional Technology Program
Department of Curriculum and Instruction
North Carolina State University
602K Poe Hall, Box 7801
Raleigh, NC 27695-7801
919-515-6229
kevin_oliver@ncsu.edu

Volume 11, Number 3: July 2010
ISSN: 1535-0975

Abstract

This study of teachers in seven Early College High Schools depicts readiness for using laptops at the implementation phase of one-to-one computing based on how well they met and addressed standards for teachers in intensive technology environments (ISTE, 2000). Key findings suggest teachers entered the pilot with mixed expertise and leveraged each other and students to address knowledge deficiencies. Teachers were occupied with classroom behavioral monitoring to deny students access to undesirable material, and they utilized system-based professional development to adopt new practices and increase classroom efficiency. Transitions to student-centered projects and collaborative work were anticipated and occurring in a third of classrooms observed, but independent seatwork was more frequent at implementation. Curriculum-based professional development was desired as were networks of teachers collaborating to share resources and lessons. Study findings are relevant to school leaders, technology facilitators, and staff developers supporting new one-to-one computing initiatives and to teacher educators whose graduates may require advanced preparation to meet the technology literacy demands of ubiquitous computing placements.

Keywords: one-to-one computing, ubiquitous computing, laptops, technology standards

Volume 11, Number 3: July 2010
ISSN: 1535-0975

Introduction

One-to-one computing and ubiquitous computing are popular phrases used to denote educational technology programs where every student in a given institution has consistent access to a personal computer. The phrases are best differentiated by the level of access provided with "ubiquitous computing" used to describe programs where technology is pervasive but not necessarily one-to-one and "one-to-one computing" used to describe programs where every student does indeed have their own computer. One-to-one computing programs further vary in the details with some providing computer access only during school hours through labs and mobile laptop carts and others providing 24/7 computer access with laptops checked out to students for both school and home use.

In 2007, an evaluation contract was awarded by the North Carolina Department of Public Instruction to study a one-to-one computing pilot initiative in seven Early College High Schools (ECHS). Affiliated with the Bill and Melinda Gates Foundation, the ECHS program has established more than 200 alternative schools in 24 states emphasizing small class sizes and academics. The program targets students who are not likely to attend college, places them in buildings situated near or on community college campuses, and allows them to attend both high school and community college courses. A typical program of study allows students to graduate in five years with both a high school diploma and an Associate's Degree, aiding the transition to four-year universities.

With over 40 schools in the ECHS program, North Carolina provides an ideal location to study the ECHS model and layers such as one-to-one computing that may provide an added effect. In 2007, the Golden Leaf Foundation and SAS Corporation provided funds to purchase

Volume 11, Number 3: July 2010
ISSN: 1535-0975

laptops for students and teachers in seven pilot schools. Since Golden Leaf's mission is tied to transitioning rural counties out of a tobacco-based economy, seven sites were selected in rural counties around the state to receive this benefit. Additional ECHS and traditional schools have been added to the one-to-one pilot initiative each year after the initial rollout. The pilot has expanded into what is now known as the "North Carolina 1:1 Learning Technology Initiative," or a public-private partnership seeing to the necessary organization, policy, funding, community engagement, technology, professional development, and pedagogy "as necessary components of a sustainable model for supporting future-ready students in North Carolina" (Friday Institute for Educational Innovation, 2008). While the initiative has become better organized, the pilot schools detailed in this study did not receive a standard professional development or software package prior to implementation. Rather, they were primarily district dependent in terms of the training and software tools received to begin their programs. These are distinguishing characteristics of this sample worth noting.

A three-year evaluation was planned to answer three broad evaluation questions about the pilot initiative. In year one, to what extent are school leaders, teachers, students, and parents ready to utilize laptops in instruction, and what implementation issues impact their readiness? In year two, is classroom instruction changing? In year three, what are the achievement outcomes of the initiative, and is the environment sustainable? This paper discusses qualitative findings related to the year one implementation question, with a focus on teacher readiness for one-to-one computing and associated implementation issues. The presented study is situated in a larger, longer-term, mixed methods evaluation.

Volume 11, Number 3: July 2010
ISSN: 1535-0975

Conceptual Framework and Related Literature

This section outlines the conceptual framework for the study in the form of recommended technology competencies and practices for PK-12 teachers, followed by a summary of one-to-one computing literature that illustrates how well teachers working under one-to-one computing conditions typically demonstrate or struggle to meet each of the standards.

The conceptual framework for this study is based on the International Society for Technology in Education's (ISTE) National Educational Technology Standards (NETS) for PK-12 Teachers, or ISTE NETS-T (ISTE, 2000). The NETS-T represent technology competencies and practices for effective technology integration that can be used to help prepare pre-service teachers or evaluate in-service teachers' technology use. In this study, the standards are used as indicators for evaluating teachers in one-to-one computing environments (i.e., Does data show teachers were meeting standard X during the implementation phase of one-to-one computing?).

The 2000 NETS-T cover six areas of expertise (see Table 1). After collecting data in spring 2008, ISTE updated the NETS-T with modified standards (ISTE, 2008). It should be noted, however, that the old standards used to frame findings in this study closely correspond to the new standards that reference "digital age" language (see Table 1 for a comparison of topics).

Table 1

National Educational Technology Standards for Teachers (ISTE, 2000; ISTE, 2008)

Original NETS-T (2000)	New NETS-T (2008)
I. technology operations and concepts	III. model digital-age work and learning
II. planning and designing learning	II. design and develop digital-age

environments and experiences	learning experiences and assessments
III. teaching, learning, and the curriculum	I. facilitate and inspire student learning and creativity
IV. assessment and evaluation	II. design and develop digital-age learning experiences and assessments
V. productivity and professional practice	V. engage in professional growth and leadership
VI. social, ethical, legal, and human issues	IV. promote and model digital citizenship and responsibility

Research into one-to-one computing has helped to inform how well teachers teaching in these programs meet the NETS-T, as well as potential barriers they may encounter in meeting suggested competencies. Teachers have directly self-reported that one-to-one computing helps them improve experience with overall NETS skills (School Board of Broward County, 2006). And as noted in the following paragraphs, other studies suggest one-to-one computing may support an understanding and attainment of specific NETS skills.

Historically, teachers in ubiquitous computing conditions have been shown to progress through several stages of technology use on a path to truly changed instructional practice (Sandholtz, Ringstaff, & Dwyer, 1997). The path begins with a basic understanding of "technology operations and concepts," the first NETS-T. Teachers new to technology often begin by enhancing their existing teaching practices, perhaps using the internet to find external resources, or using email to communicate with parents and absent students. Teachers new to one-

to-one computing specifically may seek knowledge of technology operations that allow them to manage and minimize distractions laptops may bring to their classroom.

In terms of the second NETS-T, "planning and designing learning environments and experiences," one-to-one computing has been shown to help teachers individualize and customize instruction (Anastos & LaGace, 2007; Rockman, 2007). Laptop programs have also been found to increase opportunities for project-based learning (Rockman et al., 1998), although adapting to student-centered instruction is not immediate and takes some time (Rockman et al., n.d.; Sandholtz et al., 1997).

One-to-one computing may change how teachers address the third NETS-T of "teaching, learning, and the curriculum." Research has shown teacher communication with students may increase with new software tools that support such features as screen sharing and document markup (Anastos & LaGace, 2007). Opportunities to leverage student-to-student communication in teaching have also been shown to increase under ubiquitous computing conditions, as students have regular access to responsive technologies such as chats, messaging, blogs, and wikis (McHale, 2006; Oliver & Corn, 2008; Rockman et al., 1998). Teachers can also engage students in increased research and writing activities with positive effects shown on skills (Rockman et al., n.d., 1998; Russell, Bebell, & Higgins, 2004).

The nature of the fourth NETS-T, "assessment and evaluation," may also change in laptop settings, if students indeed are tasked with more projects scored with rubrics. Caution is warranted, however, since researchers have observed one-to-one computing can decrease formalized small group or pair work in lieu of more independent work with one's own laptop (Oliver & Corn, 2008; Russell et al., 2004). It is possible a teacher may begin to implement more

Volume 11, Number 3: July 2010
ISSN: 1535-0975

self-paced worksheets and quizzes in laptop settings that could be detrimental if students lose opportunities to work with and learn from peers as advocated by social constructivists.

One-to-one computing no doubt places new demands on teacher training to help them meet the fifth NETS-T of "productivity and professional practice." Researchers have reported teachers will need external support to achieve full productivity with new laptop tools, including technology trainers and technicians at school sites, teacher professional development, and administrative leadership that meets regularly to develop logistical plans for implementation (Bonifaz & Zucker, 2004; Zucker & McGhee, 2005). Teachers in immersive technology environments have been reported to use technology more often for their own professional productivity (Texas Center for Education, 2007) and to increase their professional productivity (Zucker & McGhee, 2005). Regular access to technology may help teachers access additional professional development from a distance.

Teaching in a ubiquitous computing environment places new demands on teachers to be aware of the sixth NETS-T, "social, ethical, legal, and human issues." Appropriate policies must be in place and enforced by teachers with regard to appropriate use of the laptop and internet. With new software tools that allow students to develop videos and other multimedia productions that may find their way onto the public Web, teachers must be aware of and teach copyright rules and less restrictive options such as creative commons licensing. Given that laptops increase student responsibility, teachers must also have plans and appropriate consequences that preferably don't academically penalize students who forget their laptops at home, misuse and break their laptops, or fail to prepare their laptops for classes with charged batteries or required peripheral devices.

Volume 11, Number 3: July 2010
ISSN: 1535-0975

Method

This study seeks to answer a readiness question about how well teachers are prepared to meet recommended technology standards during the critical implementation phase of one-to-one computing with potential implications for better preparing, training, and supporting future teachers facing similar conditions.

Design

As noted previously, the study detailed in this paper is one part of a larger evaluation using a mixed methods concurrent triangulation design with both quantitative and qualitative data sources toward a goal of expanding quantitative results with qualitative data (Creswell & Clark, 2007). The qualitative portion of the evaluation detailed in this paper follows a case study design where the primary unit of analysis is an individual school.

Participants

An evaluation team collected data for this pilot study of one-to-one computing, including university faculty, research associates, and graduate research assistants. Seven ECHS participated in the study. Schools did not volunteer for the pilot, but rather were granted laptops by The Golden Leaf Foundation without much choice to opt out of the program. At each school, participants included all students (grades 9-12), all teachers, the technology facilitator, and the school leadership team (i.e., principal, counselor, and district technology staff). Tables 2 and 3 list the number of students and teachers responding to surveys in year one along with gender and racial demographics of respondents to provide a snapshot of participating schools. Again, the overall number of students enrolled in each school is small by design of the ECHS program. Female students outnumber male students at all but one school. Also, white students outnumber other races at all but one school, although four of seven schools have a diverse racial mix.

Female teachers strongly outnumber male teachers at all but two schools, and a majority of teachers at each school are white.

Table 2

Student survey respondents and related demographics by school

School	Student Total	Survey Response Total	Gender		Race			
			Male	Female	African-American	Hispanic	White	Other
1 dav	113	89	33	56	2	4	75	6
2 edg	124	90	40	50	27	6	44	13
3 mac	107	78	31	47	0	3	71	4
4 nash	222	134	53	81	62	4	43	25
5 ruth	145	83	42	41	6	8	57	12
6 sand	152	93	38	55	24	8	26	35
7 way	170	167	71	96	64	9	73	21

Table 3

Teacher survey respondents and related demographics by school

School	Teacher Total	Survey Response Total	Gender		Race			
			Male	Female	African-American	Hispanic	White	Other
1	5	4	1	3	0	0	4	0
2	10	10	5	5	1	0	8	1

3	4	4	1	3	0	0	4	0
4	12	8	1	7	2	0	6	0
5	6	6	3	3	0	0	6	0
6	9	6	0	6	1	1	4	0
7	10	9	3	6	1	0	5	3

Data Sources

While multiple data sources are used in the overall evaluation (test scores, surveys, classroom observations, and interviews/focus groups), this paper is based on the qualitative observation and interview/focus group data that best informed the question of teacher readiness. Forty classrooms were observed during spring 2008 site visits across all seven schools, or an average of 5.7 classrooms per school. *Looking for Technology Integration* (LoFTI) was selected as the observation protocol based on its development in North Carolina with an emphasis on key factors promoted by the state technology integration model (SERVE, 2008). The instrument captures information on the classroom environment and student grouping, student engagement, hardware and software tools in use, how teachers are using technology (e.g., activating prior knowledge, demonstrating, providing feedback), and how students are using technology (e.g., discussing, testing hypotheses, problem-solving, project-based activities).

An original interview/focus group protocol was designed for the study with questions to inform school infrastructure, teacher alignment with ISTE (2000) technology competencies, and the influence of laptops on instructional practices, student achievement, and student 21st century skills. Question topics were informed by previous one-to-one computing studies (e.g., Muir, Knezek, & Christensen, 2004) and driven by interests of partner agencies.

Volume 11, Number 3: July 2010
ISSN: 1535-0975

Procedures

ECHS pilots received laptops in early winter 2008 and held mandatory orientations with both students and parents. Site visits were conducted at the seven pilots for the first time in April, and included classroom observations, an interview with each school's technology facilitator, and separate focus groups with each school's teacher and leadership teams. Each site visit was conducted by at least two members of the evaluation team, with a senior member of the team on every visit. Follow-up site visits will be conducted every semester throughout the three-year evaluation.

Observations coincided with announced site visits, so teachers were aware observers were coming to their classrooms, but were not asked to prepare any special lessons. One observer visited every content area teacher in the pilot at least once during implementation, with each observation lasting 30 minutes. While different members of the evaluation team conducted observations, the protocol was discussed at team meetings in advance of data collection with definitions of key terms compiled, discussed, and carried by observers to classrooms to clarify terms as needed (e.g., what constitutes "cooperative learning"). *SurveyMonkey* was used to place the LoFTI instrument online in a form that observers accessed wirelessly to complete their reviews.

At each of seven schools, two focus groups were held with the leadership and teacher teams, and one interview was conducted with the school technology facilitator for a total of 21 recorded sessions. During each focus group and interview, participants were asked the same set of questions, including questions designed to inform how well ECHS teachers met ISTE's NETS-T at the implementation stage of one-to-one computing (see Table 4 for sample questions). The

length of focus groups and interviews varied according to participant responsiveness, but most sessions lasted 30-60 minutes during available planning periods. While different members of the evaluation team conducted the focus groups and interviews, they were trained to maintain the integrity of the protocol and ask the same questions in the same order to all groups. Conversations were audio taped, transcribed through external contract, and finally imported into *Atlas.ti* software for qualitative analysis.

Table 4

Sample focus group and interview questions aligned with ISTE's NETS-T

ISTE Standard	Teacher Focus Group Questions	Related Technology Facilitator Interview Questions, and Leadership Team Focus Group Questions
I. technology operations and concepts	Do you feel comfortable operating a laptop and helping your students do the same?	Do you feel that your teachers are comfortable operating a laptop and helping their students do the same?
II. planning and designing learning environments and experiences III. teaching, learning, and the curriculum	How do you feel the laptop program will change the learning environments and experiences you design?	How do you feel the laptop program will change the learning environments and experiences your teachers design?
IV. assessment and	Do you think a laptop program	Do you think a laptop program will

evaluation	will improve student learning and achievement at your school?	improve student learning and achievement at your school?
V. productivity and professional practice	What added professional development will you need as a result of the laptop program?	What added professional development will your teachers need as a result of the laptop program?
VI. social, ethical, legal, and human issues	How does continual student access to a laptop concern you with regard to legal, ethical, or safe practices?	How have you addressed teacher and student knowledge of social, legal, ethical, and safe practices with regard to using laptops?

The quantity of data generated by the overall evaluation necessitates dividing quantitative and qualitative analyses among the evaluation team with different researchers focusing on different topics of interest, such as the teacher readiness question addressed by this paper. Weekly team meetings allow researchers to compare themes during the analysis phase toward a goal of reporting overall results to partner agencies.

Credibility and Dependability

The following procedures were employed to ensure the data collected were credible and dependable:

- Triangulation of Human Sources: The interview/focus group protocol asked the same teacher-focused questions to three separate groups at each school to determine if there was agreement on teacher challenges and opportunities within a school, rather than relying solely on teacher self-report. While no agreement on teacher readiness was assumed across schools,

cross-case analysis was employed to define common challenges and opportunities recurring at multiple pilot sites.

- Peer Debriefings: The evaluation team meets weekly to discuss project matters such as instrumentation and analytical needs. Consistent with investigator triangulation (Denzin, 1978), members of the evaluation team returning from a site visit share data trends and preliminary hypotheses with members who did not go on the site visit to determine if their assumptions are reasonable and if they offer deviant cases or match findings from other sites. Weekly meetings also allow the team to review procedures and clarify definitions of terms on the observation and interview/focus group protocols to ensure consistency in data collection.
- Prolonged Engagement: While the study described in this paper does not meet the definition of prolonged engagement, ongoing site visits are a key component of the overall evaluation plan, with members of the evaluation team budgeted to spend a day at each school every semester throughout the three-year evaluation period.

Analysis

Analysis began by open-coding the teacher focus group, technology facilitator interview, and leadership team focus group for the first school with *Atlas.ti* software. This was followed by a comparison and coding of the data from each subsequent school in turn, with initial codes collapsed into categories as patterns emerged (e.g., concerns about the laptop program and benefits of the laptop program were two categories that emerged from lower-level, singular issues such as increased cheating and differentiation). Categories emerging from the initial cross-case analysis were then sorted into conceptual themes of interest (i.e., ISTE's six NETS-T) to illustrate teacher alignment with standards based on their knowledge of issues and plans for using laptops at the implementation stage of one-to-one computing.

Volume 11, Number 3: July 2010
ISSN: 1535-0975

Given that each school's staff was small and highly collaborative, the primary unit of analysis was the entire school (i.e., teachers, leaders, and technology facilitator). The cross-case analysis procedure, therefore, did not attempt to differentiate comments by school role (i.e., teacher versus facilitator), but rather to accumulate evidence for how many schools were experiencing similar or divergent issues at the implementation stage.

Limitations

While multiple data sources were analyzed in this study, student perspectives were not considered for how well teachers incorporated laptops into instruction during the implementation of the pilot. In year two, the evaluation team acknowledged the need to gather student perspectives and added a student focus group to every site visit, but the question of teacher readiness in year one was addressed primarily by data from adults.

Study findings are based on a cross-case analysis of seven ECHS in North Carolina, helping to identify similar or divergent issues during the implementation of one-to-one computing in these related organizations. While study findings may be generalizable to similar ECHS, findings lack generalizability to other settings particularly given the unique nature of ECHS that emphasize small school and class sizes with a very limited number of teaching faculty.

Findings

Teacher Readiness for Standard I: Understanding Technology Operations and Concepts

When asked if teachers were comfortable operating their new laptop and helping students do the same, most schools indicated their teachers had a mix of expertise from basic to advanced. Four schools discussed teachers progressing in their use of laptops and becoming more comfortable and willing users over time, as noted by one technology facilitator:

> I saw a lot of resistance when we started putting the computers in the classrooms, from a lot of teachers--they were just like, what am I going to do with this? Some of those same teachers now can't teach their class without it, they really are upset if their computer doesn't work....

Administrators at two schools indicated teachers at more basic levels had learned it was okay to ask for assistance when needed:

> Our teachers here, the majority of them are willing to ask questions. Miss X is not afraid to say, "Hey, how do you do this?" and get a student to come over and to show her how to do that. So I think that's invaluable, where the teachers are willing to be students as well. And that's an important lesson for the students to learn, is that when they leave us, they don't know it all, and that's okay.

Teachers who needed technical assistance at the implementation stage received it primarily from their own students and peers. The most common form of teacher assistance was help from students, discussed by a full six of seven schools. Student help was leveraged both informally as well as formally by a few schools that had implemented student technology teams to provide technical support to teachers. Two administrators noted:

> I think the teachers are comfortable on a baseline, they have a baseline of knowledge, but there are students here that are way on the other end of the spectrum. They're teaching us!

> The digital learning club has helped with troubleshooting, when there's something real immediate and the technicians are off-campus. That's something the teachers feel like they can go to. For the most part, it's made up of kids that maybe traditionally would not have an active role in helping, so it gives them a sense of pride almost.

Volume 11, Number 3: July 2010
ISSN: 1535-0975

Three schools discussed teachers collaborating to provide technical help to one another, which may not be uncommon in an early college environment where only 4-6 teachers are employed per site and may be more collaborative in general than at larger schools. One administrator noted:

> One good thing is, as all of our faculty learn things, we help each other. I mean, we're the lead, but we'll show somebody how to do it, and later another teacher may have a question, and they'll jump in and they'll teach what they have learned, so it's very collaborative....

Comments from several technology facilitators and teachers revealed that one focus at the implementation stage of one-to-one computing was on increasing classroom efficiency. In terms of technology operations and concepts, teachers were first learning to leverage the new technology to make their existing instructional practices more efficient by distributing notes and collecting assignments electronically, not necessarily more effective with changed instructional practices:

> More time in the classroom, now they can submit their work electronically, so you don't have to go around and collect a paper, hand stuff out, just e-mail it to them and boom they are working.

> [Teachers at regular schools] are used to having the first 30 to 35 minutes of students taking notes off the whiteboard, or using you know their projector, so this opens up so much more time, because you prepare the notes, you send it to them, have them, tell them where to look, and so it's making the students use it more.

> Like instead of using construction paper, they can just go on paint. I was just sitting here today, an activity I can do, instead of cutting shapes out, just go on to the paint thing or whatever and just make the shapes.

> I do most of the day-to-day staff development.... This teacher may still be using a Promethean like a chalkboard. The next teacher... how can we incorporate it more interactively, how can we make the students more involved, instead of you standing up there writing the day's announcements on it, or using it as a video projector. ... Efficiency is our big focus at this point... as we move on, becoming more effective.

Teacher Readiness for Standards II and III: Planning and Designing Learning Environments, Teaching with Technology

When schools were visited in April, personnel were asked if laptops were changing or might change the lessons that teachers design and teach, covering two of ISTE's NETS-T. While it was not expected teachers would have substantially changed their lessons at implementation, responses to this question helped to inform schools' beliefs about how laptops were expected to change classroom teaching.

Across the seven schools, over 23 different suggestions were made for how laptops were changing or might change instruction. Only seven suggestions, however, were made by three or more schools. Leading the list, five schools suggested laptops would significantly reduce actual teacher lecturing and place teachers more in the role of facilitator. Observation data supported this assertion with facilitation and questioning observed in 26% and 37% of classrooms visited

respectively, compared to lecture observed in only 11.6% of classrooms visited. Two administrators noted:

> The teachers are just going to have to step off the stage.... The 45 minute lectures just won't work anymore with all the information. They're not the container of knowledge. Knowledge doesn't flow from them. All they can do is help students find the best information and gather the knowledge from all these various sources.

> When you have such a tool where students can direct their own learning, then it's going to have to change how a lesson is presented or how a lesson is planned. You don't know what the student is going to find out, so you have to be willing to release some of the control, which is awfully scary.

Complementing the prediction of increased facilitation, four schools indicated laptops would enable or enhance project-based work, with the caveat that projects take considerably more class time. Project-based activities were observed in 28% of classrooms visited. One teacher noted:

> It would be very easy to turn everything into a project now, and sort of have the pendulum swing the other way where you're totally constructivist and totally facilitating, but then that takes sometimes four times as long as the traditional style of us delivering content, so there's a lot of decisions to be made.

Given the requirements of student-directed, project-based work, it is not surprising that three schools each suggested laptops would allow teachers to give more responsibility to the students

Volume 11, Number 3: July 2010
ISSN: 1535-0975

for their own work, and students to conduct more independent research. Indeed, observation data indicates students used technology as a tool for research in 33% of classrooms visited, and the most commonly observed tools in use were Web browsers in 40% and search engines in 32% of classrooms visited. Surprisingly, however, no teachers suggested laptops would support student communication, since projects are often collaborative in nature. One teacher mentioned a wiki as a tool that could possibly support collaboration, but she admitted a lack of knowledge about strategies to help students collaborate through technology:

> Right now we are doing projects with the kid and the computer and that's it. I would like to involve the whole class on the project... maybe with the wiki idea.... I need to really figure out how to get the kids involved with each other, so I know for now it's just the computer-kid, and that's it.

Observation data indicate the most common instructional grouping across the pilot schools was independent work in 53.5% of classrooms observed, followed by whole group activity in 46.5% of classrooms observed, and finally small group work in 30.2% of classrooms observed. Collaborative work did occur, but was not as frequent as independent and whole group activity. Laptops may help to increase collaboration around projects as suggested by one technology facilitator:

> We've been working at becoming more project-based... I think it's going to be easier... they've been lacking the tools to make it as cooperative as it possibly could have been in terms of projects.

Volume 11, Number 3: July 2010
ISSN: 1535-0975

Five schools suggested having laptops would increase teacher versatility, allowing them to better leverage Internet resources and software in the classroom, as with this teacher quote:

> Being English, the Scarlet Letter hasn't changed in the last couple hundred years, but what has happened is I had some students that found the audio version, and what they really wanted to do was listen, and I encouraged them to read along as they listened, learn that vocabulary.

With increased access to a greater variety of resources and tools, four schools suggested laptops would allow teachers to better individualize and differentiate instruction as represented by the following teacher quotes, although differentiation was only observed in 9% of classrooms visited:

> When we would do differentiated lessons in the past, you're lugging carfuls of materials for this kid who wants to do something visual, this kid wants to do something paper, this kid wants to do a packet. This way, you have Moviemaker, you've got Word or OneNote or Powerpoint, those tools are there, those materials are there....

> It gives me an opportunity for differentiation, and I didn't do it as much before, because before I would have to make physical copies, set up five or six different centers, but with the laptops I can just say, "OK, you're going to this place, you're going to this place."

Teacher Readiness for Standard IV: Applying Technology to Effective Assessment and Evaluation Strategies

Volume 11, Number 3: July 2010
ISSN: 1535-0975

During interviews and focus groups, several comments hinted at teacher understanding for how laptops might be leveraged to assess students. These comments generally fell into two categories--monitoring and alternative assessment.

Most schools in this initiative were implementing the classroom monitoring software *DyKnow* (2008), which allows teachers to view any student's computer screen to monitor what they are working on, distribute materials, and also set up electronic feedback mechanisms to gauge student understanding at any point in a presentation. At implementation, most teachers wanted to use monitoring software to monitor student activity. Only a few schools discussed the value in assessing student understanding on the fly to alter the pace and direction of instruction. Teachers at four schools asked for professional development to implement the tool more effectively:

> We have a DyKnow person coming next week, so for us a lot of how do we use it to monitor? But being able to go to that next professional step, how do you really meet those best instructional practices using the technology?

In discussing how laptops would change classroom instruction, a few schools indicated they expected more student-directed projects, group work, and presentations, which would serve as fodder for alternative forms of assessment, as represented by the following teacher quote:

> It's surprising the information they can get about other countries... that changed the way I think about assessment, because I use the list on Blackboard, so at least now they can see what all the kids are doing.... It used to be that you just give it to me, and I give it back to you, now they can see everybody else's [work].

Two schools requested professional development on helping students set up portfolios, suggesting some schools were thinking about how to collect and score artifacts, as with this teacher statement:

> One of the things... is the electronic portfolio, and kind of that next step... they've got their notebooks in one project, Moviemaker, how do we start gathering that so that the kids have this picture of their high school education? ... haven't really gotten past the idea of how do we start collecting that instruction.

Teacher Readiness for Standard V: Enhancing Productivity and Professional Practice through Technology

ISTE suggests teachers use technology to enhance professional practice, including accessing professional development. All schools reported providing teachers with some form of professional development at the beginning of this initiative, however the subject of this professional development varied widely. Over 21 different professional development offerings were described, but only two were discussed by three or more schools--training on SAS in Schools' *Curriculum Pathways* software in four schools (a partner in the initiative) and training on the *DyKnow* classroom management software in three schools.

Other trainings discussed by one or two schools included training on laptops and wireless connectivity, operating systems, classroom Promethean or Smartboard systems, *Moodle* or other course management systems, *Microsoft Office* software, multimedia software such as *iPhoto* and *iMovie*, and the "big three" Web 2.0 tools--wikis, blogs, and podcasts. Web 2.0 is a term given to

Web-based software applications that allow groups of users to collaborate around the production of some knowledge product (e.g., an article, a concept map, a comic strip, etc.).

Five schools described three or four trainings, while two schools described six and nine respectively, suggesting the depth of professional development by site may vary as widely as the topic areas covered. No attempt was made at the rollout of this initiative to standardize the training provided by school technology facilitators or external agencies, although a one-to-one Learning Collaborative for one-to-one schools in North Carolina was formed after rollout which is now providing some standardized training attended by pilot school teachers (Friday Institute for Educational Innovation, 2010).

Schools also listed 23 professional development sessions they would like to have offered. This list of desired trainings fell into similar categories as the offered trainings, suggesting an opportunity exists to share expertise if teachers at one school have already been trained on and implemented a tool that teachers at other schools wish to use. The most desired professional development offering was *DyKnow* classroom management software, requested by six of seven schools, which might suggest schools at the implementation stage of one-to-one have more concerns about managing student behavior than modifying instruction. Four of seven schools, however, also requested training on planning lessons with their new laptops, including interdisciplinary and differentiated instruction, so there was good acknowledgment of the opportunity to modify instruction through the new laptops (e.g., three schools desired training on *Geometer's Sketchpad* software).

Schools discussed different strategies to address professional development needs. Five schools suggested it was very important for teachers in a subject area to communicate with and share lessons with other teachers of their subject, and four schools recommended establishing a

Volume 11, Number 3: July 2010
ISSN: 1535-0975

professional learning network for pilot teachers to communicate and share lessons. One teacher noted:

> I'd like to get all the science teachers in this program, and set up a way of compiling lesson plans or websites that are good for this topic, because I've got some that were good and some that weren't.

Five schools also described the importance of building on teachers' expertise, with different suggestions for how that could be accomplished--asking teachers what professional development they need, requiring teachers to develop and teach a lesson with tools on which they are trained, and providing follow-up and one-on-one support in the classroom after professional development, presumably by the technology facilitator.

Teacher Readiness for Standard VI: Understanding Social, Legal, and Ethical Issues Related to Technology Use

School personnel were asked to describe how they planned to address social, legal, and ethical issues pertaining to laptop use. Comments from schools indicated they were aware of a range of issues with considerable advanced planning to protect students and teachers. Five of seven schools discussed the importance of acceptable use policies and parent orientations to inform everyone of both the risks and consequences of inappropriate laptop use.

The biggest concern discussed by four schools was students accessing questionable items on the Internet. Questionable items included social networking sites which three schools found particularly troublesome with regard to student privacy and safety, copyright-protected music and video students might illegally download, and resource materials students might plagiarize to cheat on assignments. Some teachers were relieved their schools had adequate filters to block

certain web sites, while other teachers were afraid filters might be blocking too much information, and schools should rely more on student responsibility, school policies, and parental oversight to manage appropriate use. How much to block remains a topic of debate. One teacher on the side of giving students more responsibility noted:

> We could worry ourselves gray... we just decided we would let them do what they do, and we'll deal with the consequences. We have in place rules and regulations in terms of what they're supposed to do and what they're not supposed to do... it's probably going to cause some frustrations, but you have to give the kids responsibility to fall or stand.

How to penalize students who break rules was another issue discussed by schools with potential academic ramifications. At least two schools had experimented with taking away students' laptops in school for a day, week, or month, depending on the offense. One of these schools also discussed collecting troublesome students' laptops at the end of a school day, not allowing them to take their laptop home. One teacher stated:

> I had this conversation with my kids yesterday, the laptop is not a right, it is a privilege, and if you abuse it, it's not guaranteed that you're going to keep it.

Discussion

In this section, findings are compared to prior one-to-one computing research, partially illustrating the results seen are not unique to early college settings. Teachers' initial focus on management issues and adopting technology to support existing instructional practices at implementation was mixed with some advanced uses of laptops aimed at improving classroom efficiency and increasing student-centered activities. Continuing data collection will define the extent and speed of teachers' transitions to more advanced uses of laptops.

Volume 11, Number 3: July 2010
ISSN: 1535-0975

Teachers expressed great interest in classroom management and monitoring software at implementation. *DyKnow* monitoring software was the most commonly requested professional development session by six of seven schools, and one of the most commonly offered professional development sessions in three schools. Although there was some acknowledgement that monitoring software could be used for assessing student understanding during a lesson, additional professional development and practice were needed to encourage monitoring for formative assessment purposes. Most teachers were interested in monitoring student behavior initially, with four schools expressing concerns over students accessing social networking sites, illegally downloading copyrighted media, or copying and plagiarizing work. Some teacher concerns are legitimate, since prior studies have shown laptops may lead to off-task behavior by high school students such as listening to music or sending notes during class, and accessing inappropriate material (School Board of Broward County, 2006). Early teacher concerns on management and monitoring fit within the first management stage Sandholtz, Ringstaff, and Dywer (1990, p. 4) proposed for ubiquitous computing environments--"survival." When teachers are unfamiliar with new technologies and can't anticipate what problems might occur, their initial focus is on misbehavior, technical problems, and changes in classroom dynamics such as increasing noise levels.

At implementation, teacher training was most commonly focused on laptop usage, troubleshooting technical problems, operating systems, wireless networks, monitoring software, course management systems, and peripheral systems such as Smartboards. With so much to learn up-front, it's not surprising that researchers have found laptops increase the planning time needed for teachers (Zucker & McGhee, 2005). The drain on time is likely highest at implementation when it would be difficult for teachers to focus on changing lessons while simultaneously trying

Volume 11, Number 3: July 2010
ISSN: 1535-0975

to learn to use new hardware and management software. The evaluation team anticipated this lag by pushing to year two the overall evaluation question, "Is classroom instruction changing?"

Incidentally, teachers weren't the only ones overly focused on the technical start-up of the project. Most of the technology facilitators in this pilot described being called upon to perform technical support duties and process laptop repairs, rather than their primary job of working with teachers to effectively integrate technology into the curriculum. The lack of adequate technical support at implementation is another issue that inevitably slows the transition toward curriculum integration by distracting facilitators and teachers from their primary roles. This factor cannot be overstated, since ECHS with small enrollments around 100 students were significantly taxing the time of competent technology facilitators with technical support issues at implementation. The need for technical support at a traditional school with 1000+ students and laptops would only be exponentially higher. One partial solution may be to leverage student expertise in providing technical support. Teachers with less technical expertise in this study reported receiving much help from their own students, as reported by other studies as well (Fairman, 2004).

To help speed the integration of laptops into teaching at implementation, teachers recommended establishing networks of colleagues to share ideas, and also leveraging one-on-one support from the technology facilitator in the classroom. In one Florida study, an unexpected rate of change with a laptop program quickly transitioning to maturity was attributed largely to selecting sites for the program based on prior teacher involvement in technology training academies (School Board of Broward County, 2006). Some districts recommend providing intensive training on laptop use in content areas prior to implementation (Owen et al., 2006). A different approach was applied in this pilot, with schools selected to receive laptops by partner agencies, rather than by application, expressed interest, or advance teacher preparation.

Volume 11, Number 3: July 2010
ISSN: 1535-0975

Several years of studying Apple's Classrooms of Tomorrow with ubiquitous computing led to the development of "stages of evolution" in teachers' instructional practices (Dwyer, Ringstaff, & Sandholtz, 1990, p. 4). At the adoption stage, teachers still rely on familiar methods such as lecture and individual seatwork, and incorporate technologies such as drill and practice software that "tell" students what they need to know. In this study, teachers spoke of technology increasing the efficiency of their existing instructional practices by distributing and collecting assignments electronically. Some of the benefits teachers proposed for their new laptop program also hinted at the adoption mindset. For one, teachers suggested laptops would benefit them with more Internet resources and increased versatility. Better teacher access to new instructional content is a commonly suggested benefit of laptop programs (Zucker & McGhee, 2005). For example, one of the most common professional development sessions offered at four schools in this study was the Web-based *Curriculum Pathways* software that teachers were excited to use as a curricular supplement. While this software merges multimedia-rich presentations with "interactivities" that engage students with questions, problems, and writing exercises, it could be considered a bridge to the purely "tool" software discussed by Jonassen (2000) which is less about presenting specific content and more about providing students with various functionalities to process and make sense of any content (e.g., analyzing with spreadsheets, testing hypotheses with simulations, relating with concept maps, synthesizing with social bookmarks). Students were observed using traditional "tool" software in 33% of classrooms visited, including word processing, spreadsheets, and databases--second only to Web browsers in 40% of classrooms. Schools overall were not promoting Web 2.0 tools at implementation, with only one school providing training on blogs, and one other school providing training on wikis and podcasting.

Although all classrooms were not at advanced stages of Dwyer et al.'s (1990, p. 6) model, teachers discussed and anticipated several transitions to more student-centered uses of the technology over time that were more consistent with the "appropriation" stage. This notion of transitioning is supported by results of prior one-to-one computing studies. Five schools indicated the laptops would change the role of their teachers from lecturers to facilitators with such activity already observed in a quarter of the classrooms visited. Prior studies support this assertion, including Owen et al.'s (2006) study of the Irving Independent School District's laptop program where the most frequently used instructional strategy was facilitating student learning. Four schools anticipated more project-based work by students, and this transition from a textbook-based to project-based classroom is precisely what other one-to-one computing pilots have reported (Greene County Schools, 2007; School Board of Broward County, 2006). Three schools indicated laptops would increase student responsibility for their own learning, which is what Fairman (2004) reported in Maine where student-centered and inquiry-based approaches shifted the role of the student to one of increased responsibility. Three schools also anticipated laptops would allow their students to conduct more online research. Observations provided evidence for research activities, with other one-to-one studies reporting this is how a majority of teachers and students report spending their time (Owen et al., 2006). Four schools suggested laptops could better support more individualized instruction, which is supported by research conducted in Maine where laptops provided students with more freedom to pose their own research questions and to research topics of interest (Fairman, 2004). Another potential benefit of laptops is increased student-student and student-teacher communication (Bebell, 2005; Fairman, 2004; Levin, 2005-06), although there was little evidence of laptop-supported collaboration occurring in this study.

Volume 11, Number 3: July 2010
ISSN: 1535-0975

As shown by other one-to-one studies, change in instructional practice does take time (Owen et al., 2006). As one teacher discussed, participation in one-to-one computing pilots may progress in "phases" with a lot of information to digest initially and various "hurdles" to overcome:

> I feel like I'm in phases. The first phase was just trying to wrap my brain around, OK, I have this new Promethean board, and now I'm beyond that and I'm into how can I use my existing notes with the Promethean board, and we talked about that with the trainer we had last week. So we're constantly adapting and changing ourselves, and as that changes, our lessons, like I'm looking forward to next year, because I've got a real feel for how I can incorporate everything we have, like the Promethean board and the DyKnow, and my notes with [Curriculum Pathways software], so it's all coming together eventually, but we have to jump over one hurdle at a time. It's just too much for my brain to wrap around.

Recommendations

This study depicts teacher readiness for using laptops at the implementation phase of one-to-one computing based on how well they met and were prepared to address standards for teachers in intensive technology environments (ISTE, 2000). Findings allow evaluators to compare pilot schools to other one-to-one studies at implementation, and to track changes in teacher knowledge, skill, and focus in years two and three of the evaluation.

Further, findings inform recommendations to help teacher educators, school leaders, technology facilitators, and staff developers expedite a teacher's transition from a management-oriented to a student-centered laptop classroom:

- Supporting Teacher Readiness for Standard I--Understanding Technology Operations and Concepts: Plan for adequate technical support and formalize a plan to leverage student technical expertise in response to teacher and peer technical support questions. Promote a collaborative environment where teachers are encouraged to ask their peers and students questions.
- Supporting Teacher Readiness for Standards II and III--Planning and Designing Learning Environments, and Teaching with Technology: While initial professional development may focus on new tools and processes that make classroom management more efficient, teacher training must also include strategies for curriculum integration. One specific focus of laptop professional development should be on supporting project-based and collaborative student work with appropriate tool software and online research, since independent seatwork tends to be more common with students accessing teacher-distributed materials. Differentiation is another suggested benefit of laptop programs that may be easier discussed than applied in practice without training on concrete approaches and tools that support divergence.
- Supporting Teacher Readiness for Standard IV--Applying Technology to Effective Assessment and Evaluation Strategies: If professional development includes training on monitoring software such as *DyKnow* (2008), train teachers to use the software for formative assessment in addition to its more common use for behavioral monitoring. Since laptops may lead to more project-based and collaborative work, train teachers to alternatively assess these non-traditional artifacts of understanding through such mechanisms as rubrics and portfolios.
- Supporting Teacher Readiness for Standard V--Enhancing Productivity and Professional Practice Through Technology: Ask teachers what professional development they need, but realize early concerns will be on managing classrooms and school leaders may need to push

curriculum integration training. Ideally, teacher professional development on curriculum integration strategies would precede laptop program implementation, and teachers would have access to a technology facilitator and network of peers teaching in their subject area to share and collaboratively plan new lessons.

- Supporting Teacher Readiness for Standard VI--Understanding Social, Legal, and Ethical Issues Related to Technology Use: Teachers have legitimate concerns about students accessing illicit and unsafe material on the Web and using copyrighted and plagiarized material in their work. Establishing expectations through student-parent orientations and acceptable use policies is one approach, although contingencies must be in place for rule breakers. Teachers and school leaders should carefully consider the academic ramifications of punitive actions such as blocking Web sites and taking away laptop "privileges" before establishing penalties.

References

Anastos, E., & LaGace, D. (2007). Scaling 1:1 practices. *Threshold, 5*(1), 25-28.

Bebell, D. (2005). *Technology promoting student excellence: An investigation of the first year of 1:1 computing in New Hampshire middle schools*. Chestnut Hill, MA: Technology and Assessment Study Collaborative.

Bonifaz, A., & Zucker, A. (2004). *Lessons learned about providing laptops for all students*. Boston, MA: Education Development Center (EDC).

Creswell, J. W., & Clark, V. L. P. (2007). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage Publications.

Denzin, N. (1978). *Sociological methods: A sourcebook* (2nd ed.). New York, McGraw Hill.

Dwyer, D. C., Ringstaff, C., & Sandholtz, J. H. (1990). *The evolution of teachers' instructional beliefs and practices in high-access-to-technology classrooms* (Apple Classrooms of Tomorrow Report #8). Cupertino, CA: Apple Computer, Inc.

DyKnow. (2008). *DyKnow Software--engage and interact, minimize distractions.* Retrieved October 17, 2008, from http://www.dyknow.com/

Fairman, J. (2004). *Trading roles: Teachers and students learn with technology*. Orono, ME: Maine Education Policy Research Institute.

Friday Institute for Educational Innovation (2008). *North Carolina Learning Technology Initiative: Framework for planning*. Retrieved May 21, 2010, from http://www.fi.ncsu.edu/assets/research_papers/nc-11-learning-technology-initiative-planning/nclti-planning-framework-.doc

Friday Institute for Educational Innovation. (2010). *The NC 1:1 Learning Collaborative*. Retrieved May 21, 2010, from http://www.fi.ncsu.edu/project/nc-11-learning-collaborative/

Greene County Schools. (2007). *Integration of technology- iTECH program website*. Retrieved July 5, 2007, from http://www.gcsedu.org/site_res_view_folder.aspx?id=39638ac1-5cac-4ddd-9c78-21342c35d655

ISTE. (2000). *ISTE NETS for teachers*. Retrieved July 25, 2008, from http://www.iste.org/Content/NavigationMenu/NETS/ForTeachers/2000Standards/NETS_for_Teachers_2000.htm

ISTE. (2008). *ISTE NETS for teachers.* Retrieved October 17, 2008, from http://www.iste.org/Content/NavigationMenu/NETS/ForTeachers/2008Standards/NETS_for_Teachers_2008.htm

Jonassen, D. H. (2000). *Computers as mindtools for schools: Engaging critical thinking* (2nd ed.). Upper Saddle River, NJ: Merrill.

Levin, H. (2005-06). Laptop program update: Reflections on the effects of one-to-one computing in a high school. *Learning and Leading with Technology, 33*(4), 17-20.

McHale, T. (2006b). One-to-one in Ohio. *Technology & Learning, 27*(4), 30-32.

Muir, M., Knezek, G., & Christensen, R. (2004a). *The Maine learning technology initiative* (Research Brief MLLS0401). Farmington, ME: Center for Meaningful Engaged Learning.

Oliver, K. M., & Corn, J. O. (2008). Student-reported differences in technology use and skill after the implementation of one-to-one computing. *Educational Media International, 45*(3), 207-220.

Owen, A., Farsaii, S., Knezek, G., & Christensen, R. (2006). Teaching in the one-to-one classroom: It's not about laptops, it's about empowerment! *Learning and Leading with Technology, 33*(4), 12-16.

Rockman *ET AL* (n.d.). *A more complex picture*. Retrieved July 10, 2007, from http://download.microsoft.com/download/8/d/c/8dc3ebfe-6849-4534-a4b7-846a8c327874/Research3Report.doc

Rockman *ET AL* (1998, October). *Powerful tools for schooling.* Retrieved July 10, 2007, from http://www.microsoft.com/education/downloads/aal/research2.rtf

Rockman, S. (2007). It's my laptop. *Threshold, 4*(4), 21-25.

Russell, M., Bebell, D., & Higgins, J. (2004). Laptop learning: A comparison of teaching and learning in upper elementary classrooms equipped with shared carts of laptops and permanent 1:1 laptops. *Journal of Educational Computing Research, 30*(4), 313-330.

Sandholtz, J. H., Ringstaff, C., & Dwyer, D. C. (1990). *Teaching in high-tech environments: Classroom management revisited* (Apple Classrooms of Tomorrow, Report #10). Cupertino, CA: Apple Computer, Inc.

Sandholtz, J. H., Ringstaff, C., & Dwyer, D. C. (1997). *Teaching with technology: Creating student-centered classrooms.* New York: Columbia University Press.

School Board of Broward County. (2006). *Digital learning environment study (DLES) and curriculum development/instructional management (CD/IM) evaluation report*. Retrieved August 25, 2008, from http://www.broward.k12.fl.us/it/report/index.htm

SERVE. (2008). *Looking for technology integration (LoFTI).* Retrieved July 25, 2008, from http://www.seirtec.org/Evaluation/Capacity/EvalFramework/resources/LoFTI.php

Texas Center for Educational Research. (2007). *Evaluation of the Texas technology immersion pilot: Findings from the second year*. Retrieved August 25, 2008, from http://www.etxtip.info/images/eTxTIP_Year2EvalRptSumm.pdf

Zucker, A. A., & McGhee, R. (2005). *A study of one-to-one computer use in mathematics and science instruction at the secondary level in Henrico County Public Schools*. Retrieved August 25, 2008, from http://ubiqcomputing.org/FinalReport.pdf