A Computer for Every Student and Teacher: Lessons Learned about Planning and Implementing a Successful 1:1 Learning Initiative in Schools


Abstract: Twelve high schools in NC piloted a 1:1 learning initiative where every teacher and student received a laptop computer with wireless Internet access provided throughout the school. The overall goals of the initiative were to improve teaching practices; increase student achievement; and better prepare students for work, citizenship, and life in the 21st century. A longitudinal evaluation study in the NC high schools focused on the schools’ progress toward implementing the 1:1 initiative and the barriers, successes, and lessons learned at various stages of implementation. A combination of teacher and student surveys, focus groups, interviews, classroom observations, and existing school-level data were collected from study participants. Analysis of these data revealed specific recommendations about deployment, wireless network, hardware and software tools, policies and procedures, support personnel, professional development, school leadership, and sustainability for a successful 1:1 learning initiative.
In the spring of 2008, the North Carolina State Board of Education awarded a contract to the Friday Institute for Educational Innovation to conduct a 3-year evaluation of a one-to-one (1:1) pilot initiative in 12 public high schools. These pilot schools included seven Early College High Schools (ECHS) and five large traditional high schools, with a total of approximately 6,000 students and 400 school staff. In these schools, every teacher and student received a laptop computer with wireless Internet access provided throughout campus. The overall goals of the initiative were to improve teaching practices; increase student achievement; and better prepare students for work, citizenship, and life in the 21st century (Corn, 2009; Corn & Osborne, 2009; Corn, Osborne & Halstead, 2008).

The evaluation study in NC focused on the schools’ progress toward implementing their 1:1 initiative and the barriers, successes, and lessons learned at various stages of implementation. A combination of teacher and student surveys, focus groups, interviews, classroom observations, and existing school-level data were collected from study participants. Analysis of these data has revealed specific recommendations about implementing a 1:1 learning environment; the most notable lesson is recognizing that it takes administrators, teachers, and students time to adjust to the significant, systemic changes enabled by the introduction of a 1:1 learning environment.

The recommendations detailed in this paper are based on the longitudinal evaluation study with 1:1 high schools in NC. Certain critical issues were found to be vital and highly interrelated (see Figure 1) to the success of a 1:1 initiative: deployment, wireless network, hardware and software tools, policies and procedures, support personnel, professional development, school leadership, and sustainability.

Figure 1. Important and interrelated issues for a successful 1:1 computer learning initiative.
Deployment

One clear recommendation is that schools should allow at least six months for planning and preparation before distributing laptops to students. Furthermore, it is best if teachers get their laptops during the second semester of the school year, and students receive their laptops at the start of the following school year. Teachers in the study recommended that laptop distribution to staff coincide with professional development in using them, including basic training with the hardware, software, and Internet resources that teachers are expected to use in the classroom. One principal suggested that “teachers get [the laptops] before school ends, they get all summer with the laptops to do professional development, and then students get them in the fall when they get back - that’s definitely the ideal.” When planning 1:1 initiatives, teachers and administrators agree that it is best to have extensive professional development prior to utilization of laptops in the classroom.

Wireless Network

The capacity of the school’s infrastructure is critical to the success of a 1:1 learning environment. Many of the older school buildings need to be retrofitted with the necessary electrical wiring to support the power needs of the laptops, projectors, whiteboards, printers and other equipment. Schools need to ensure that wireless Internet access, server access and bandwidth are appropriate given the substantial demands of student usage. In the participating schools, there was inconsistency in access to the wireless system across locations in some schools.
Staff and students reported that the strength of the wireless system could be vastly different from room to room or within areas of a single room, which interferes with effective use of the laptops. Staff in the pilot schools recommended placing wireless access points in every classroom. Each school considering a 1:1 initiative should undergo a technology evaluation to assess its current infrastructure and identify specific recommendations and costs for how to move forward regarding upgrades and connectivity.

**Hardware Tools**

*Digital Learning Devices.* Lenovo, Apple, Hewlett-Packard, and Dell were selected through a bid process to serve as the laptop vendors for the schools in this study. Two schools selected tablets and the remaining ten selected laptops. Participating school staff noticed that buy-in to the 1:1 initiative seemed to come more rapidly with tablets, especially from teachers because a large portion still prefer to hand-write instead of type. It was also an easier transition for math and science teachers, because writing equations and scientific notation is much faster than typing. School and district technology staff in these high schools insisted that selecting the appropriate computing device is of utmost importance for a successful 1:1 initiative. The optimal device maximizes learning and engagement at a sustainable cost, whereas the selection of a device that is not compatible with the current or future technological infrastructure could cripple a new initiative. “In order to select the appropriate device, schools and districts should consider six critical questions:

1. Will the computing device be used for a singular purpose or as a multipurpose software-ready and Internet-capable machine?
2. What operating system do you have the resources to support?
3. Do you want to install local applications, use web applications, or both?
4. Do you want to install local content, use web content, or both?
5. Will you be using peripheral equipment?
6. What can you do to protect the computing device from the regular wear and tear of everyday use by students and staff?” (p. 14-15, Bouterse, Corn & Halstead, 2009)

*Power.* A major challenge reported by teachers was the limited battery life of laptops. Electrical outlets were not easily accessible from student and teacher desks or workstations, and teachers cited safety concerns when power cords were laying across the classroom floor. Staff and students suggested having charging carts available at school to address this issue, in addition to rewiring classrooms to add more outlets throughout the school.
**Peripherals.** Additional hardware, equipment, and supplies considerably supported effective use of laptops for teaching and learning. Digital cameras, flip video cameras, microphones, speakers, and scanners were recommended for the development of student multimedia projects. School staff also recommended that students receive USB drives or that teachers receive external hard drives to store student work in lieu of a more robust school network for backing up student documents. Teachers suggested equipping every classroom with a projector, printer and an interactive whiteboard. Schools without tablet computers recommended Wacom tablets or Interwrite pads to aid math and science teachers and students with writing equations, or purchasing a classroom set of tablet computers for math and science classes. Science teachers recommended science-specific peripherals (e.g. digital microscopes; digital devices for measuring temperature, chemical composition, and motion) to facilitate data collection and analysis in hands-on labs.

**Repairs.** Approximately 25% of the student laptops required some repair. Schools with tablets identified broken screen latches and broken battery and hard drive covers as the biggest problems. For schools with traditional laptops, broken screens were the most frequent, costly, and time-consuming repair issues. Laptops with broken screens had to be sent back to the manufacturer, which resulted in considerable wait-time for processing, shipping, and repair. Broken screens typically occurred as a result of storing the laptop in an overloaded backpack or accidentally dropping the machine. The most common screen issues reported by students included “black” screens, color fluctuations, vertical lines, and flickering images. Next-generation personal computing devices with more durable displays are recommended for use in schools.

**Laptop Loaners.** When students needed a loaner laptop because of repair or maintenance issues, or because they left their laptop at home, schools had different options available. Most schools had extra laptops on hand to lend students as needed. A general rule of thumb recommended by technical staff was to order 5-10% more laptops than a school’s needed inventory to ensure all students had laptops even when repair or maintenance issues surfaced.

**Software Tools**

**Resources for Teaching.** The primary applications teachers reported using included Microsoft Office; the Internet to support lessons with both static content, as well as interactive online games and simulations; software that interfaced with classroom hardware such as interactive whiteboards; assessment and study skills software; learning management systems; and classroom monitoring applications. Sample applications mentioned by teachers in these categories are listed below:
• MS Office and presentation tools (Word, Excel, PowerPoint, Publisher)

• Internet sites to retrieve content for lessons, such as downloadable lesson plans or student worksheets (abcteach), sites with teaching resources (United Streaming, Learn NC, SAS Curriculum Pathways, virtual museums)

• Internet sites that provide for student interaction, such as online lab simulations and gaming activities (Starfall, Brainpop, Funbrain)

• Software that interfaces with interactive classroom hardware (interactive whiteboards, InterWrite, ActivStudio, classroom performance systems/clickers)

• Assessment software (Quia, ExamView)

• Study skills software (Plato, Study Island)

• Learning management systems to store lessons/content/grades (EduPlatform, Angel)

• Monitoring software (SchoolVue, DyKnow)

**Resources for Learning.** Students reported the widest range of general applications suitable for use in any subject area, including: Microsoft Office and presentation tools; Internet browsers and search tools to aid in research; editing tools for video, audio, and web pages; note taking applications; learning management systems; e-mail; and various utilities such as calendars. Sample applications mentioned by students in these categories are listed below:

• MS Office and presentation tools (Word, Excel, Publisher, PowerPoint, Keynote)

• Internet browsers and search tools (Firefox, Safari, Internet Explorer, Google, Yahoo, Wikipedia)

• Video editing tools (iMovie, MovieMaker)

• Image editing and manipulation tools (iPhoto, Comic Life, Photoshop, Illustrator, Gimp, GoAnimate)

• Web page editors (including wikis, Wikispaces, Pb Wiki)

• Note-taking applications (Formulate Pro, OneNote)

• Learning management systems to access teacher content/grades (Angel, Moodle, BlackBoard)

• E-mail applications (Gaggle, Yahoo)

• Utilities (calendar, electronic calculators, dictionaries, Adobe PDF Reader, QuickTime)

In addition to general applications, students also listed a number of specialized software tools most likely utilized in specific subjects, including:
• Map applications (Google Earth)
• Music applications (iTunes, Garage Band, Noteflight)
• Art-specific applications (Paintbrush)
• Math-specific applications (Geometer's Sketchpad)
• Study skills software (Study Island, Study Stack, Plato Web)
• Multimedia curriculum (Discovery Education, SAS in Schools)

Microsoft Office applications (Word, Excel, PowerPoint) are still the most widely employed tools across all groups. Other than common Web 2.0 applications such as wikis and blogs, data also suggests schools are only using a handful of the thousands of free Web 2.0 applications available. This list of software used by these participating 1:1 schools is certainly not exhaustive, but at least gives 1:1 initiative planners a place to start when considering educational software options. Recommendations from teachers in this study include content-specific professional development that explores a variety of interactive, web-based software.

Policies and Procedures

All schools in the 1:1 pilot enacted policies and procedures governing acceptable laptop use. A survey of their policies and procedures showed that:

• All schools had acceptable use guidelines
• All schools had guidelines for caring for the laptops
• Some schools explicitly prohibited violent games and social networking sites
• Some schools prohibited students from installing anything on the laptop; some of these schools had random inspections to insure compliance
• Most schools collected insurance fees, ranging from $10-$50, from students
• Most schools allowed students to take their laptops home every day
• Most schools indicated they would collect the laptops during the summer
• All schools hosted one or more parent nights to provide information to parents about the 1:1 initiative, and get parental approval and commitment to support their child’s use of the laptop
• All schools required parental permission forms for students to receive a computer
School administrators in this study recommend using another school or district’s laptop policy as a model and then incorporating input from their teachers, administrators, parents, and students about what would be most effective and meaningful for your school.

Over the course of the study common issues around policy emerged that should be considered by schools or districts before implementing a 1:1 initiative. These issues of note included student participation, security and storage, virus protection, access privileges, filters, student email accounts, saving student work, discipline, cheating and cyberbullying, and classroom management.

*Daily Student Participation.* According to teachers and students, a major challenge was that not all students actually brought a laptop to school every day. Some students may not have a laptop because a) their family declined to receive a laptop by not paying the laptop fee, b) they forgot to bring their laptop to class when it was required, or c) their laptop was being repaired. Some schools participating in this study indicated that any given day up to 20% of their students would not have access to a laptop due to these issues. This was particularly inconvenient for teachers since they then had to prepare two lesson plans--one for the group with laptops and one for the group without; create “laptop buddies” where the student without a laptop would borrow one from a designated peer; or use pair or group projects mixing students who did and did not have a laptop together. These solutions provided a temporary fix and all had negative consequences on use of instructional time. Schools should consider the following possibilities to alleviate some of the pressures on teachers: lowering the cost to the student to use the laptop for the school year; keeping a few loaner laptops in each classroom for students to check out; or instituting a day-user policy allowing those students who are not participating in the 1:1 initiative due to the reasons listed above to check out a laptop each morning and return it before leaving school each day.

*Security and Storage.* Although theft and loss of laptops was not a substantial issue at any of the schools in the pilot study, many staff raised issues of security and storage for laptops when students are at school. Students at all schools were required to carry their laptops in a separate computer bag than their bookbags to prevent crushing laptops screens. Another challenge identified was the lack of an area to safely store the laptops in the schools while they were not being used. One solution to this issue has been the placement of special shelves in common areas in some of the schools to provide a safe place for the laptops during lunch. Furthermore, participating schools recommend identifying a reliable, easy-to-use tracking system for the laptops.
**Virus Protection.** Teachers and students expressed considerable frustration with virus attacks on their laptops because some schools did not protect laptops when students and staff used them at home; this led to infected files being transmitted via e-mail or flash drives when students returned to school. Therefore, a current schoolwide license of antivirus software is an essential component of any 1:1 learning environment. Additionally, many schools found they could successfully prevent most viruses by routing Internet access through the school/district server whether a laptop is used on- or off-campus.

**Teacher Access Privileges.** Teachers were deeply frustrated by the drive restoration software (e.g. Deep Freeze) on computers. Drives were set so that new settings or software could not be saved onto the computer. Many teachers in this study recommended that they should be granted some level of administrator privileges on the laptops so they could download educational software, upgrade current software, and access “blocked” websites they considered useful for their lessons.

**Blocked Websites/Filter on Student Devices.** Defining the appropriate balance between student safety, acceptable use, and access to web-based resources is difficult but necessary. To the extent students are prevented from accessing important educational resources, 1:1 learning environments will not achieve full potential. Schools need more support in addressing the requirements of the Children’s Internet Protection Act (CIPA) while providing access to valuable education resources. Models of how to create the right balance need to be explored.

**Student Email Accounts.** School staff recommended that districts provide student e-mail accounts so that teachers and students can communicate readily and schools can create permanent e-mail lists for students in their classes.

**Saving Student Work.** In some cases, there was no space on the school-based or district-provided servers to support a virtual drive for storing student work. Students were instructed to save their work on flash drives or their laptop hard drive, which was not backed up on a regular basis. Teachers indicated that a central shared drive on a secure server on which students and teachers can save work and back up important data is essential.

**Discipline.** During focus groups, students were unambiguous about one point in particular: there must be consistent enforcement of the rules and policies in every single classroom. An infraction, such as checking e-mail during class, should have the same consequences regardless of which teacher or administrator witnesses it. Information from students and staff also indicated that the most effective tool for reducing discipline issues is alerting parents to inappropriate behaviors.
Cheating and Cyberbullying. Of particular interest to stakeholders was whether students and staff at the 1:1 schools observed higher instances of cheating or cyberbullying as a result of participation in the project. Most teachers and students were in agreement that the presence of the laptops did not increase instances of cheating at their schools; they assert that the occurrence of cheating depends on an individual student’s tendencies rather than the tool a student is given. Similarly, students reported no increase in instances of cyberbullying or bullying of any kind with the introduction of the laptops. 1:1 school staff credited this low number of incidents with their efforts of raising awareness about these issues and recommended constantly talking to students about cyberbullying and cheating – both formally in student and parent laptop training sessions and informally during class discussions.

Classroom Management. Administrators, teachers, parents and students were concerned over monitoring student computer use and ensuring appropriate use of the Internet. One special category of software used by most schools to address these concerns is monitoring software. The monitoring systems used by 1:1 schools include Crosstek SchoolVue, Apple Remote Desktop, DyKnow, NetOp, EduPlatform, and OneNote. A number of technical issues were reported with some of the monitoring systems: the programs were not easy to use without training and the monitoring software had difficulty syncing correctly with the right students. Some teachers praised the systems for including a course management tool that allowed them to build lessons that students would be locked into during a class, so monitoring was not necessary. Other teachers reported difficulty with trying to monitor 30 screens using the software while also trying to teach a lesson. Although there are mixed opinions regarding monitoring software, administrators, teachers, and students said they would recommend that new 1:1 schools invest in some type of monitoring software despite the difficulty and expense of setting it up. One suggestion was to have an administrator, technician, Technology Facilitator, or teaching assistant monitor students from outside the classroom, so teachers can focus on teaching. Often the threat of monitoring, even intermittently, is enough to keep most students on task.

Support Personnel

Technology Facilitator. The important role of onsite Technology Facilitators to help teachers and students use the technology to improve learning, established in prior research, was once again confirmed. The 1:1 teachers reported that Technology Facilitators substantially assisted them in integrating their laptops into the curriculum and that having time with a Technology Facilitator available on a regular basis is an important support for teachers integrating technology into classroom practices. Technology Facilitators in this study reported that their daily
activities included conducting professional development, troubleshooting equipment and software issues, modeling technology use, and co-teaching. They also reported maintaining open communication with district technology staff as part of their regular routine. A full-time Technology Facilitator is recommended for any school considering a 1:1 initiative.

**On-site Technicians.** On-site technicians provided a vital service to facilitating seamless and continuous use of laptops for teaching and learning. Major responsibilities of the technicians in this study included responding to teacher/student requests related to software, hardware, and network problems; installing new technology resources; acting as liaison with district technical staff; coordinating warranty and other technical information with hardware and software companies; and providing input on school technology purchases. Technicians available at the school allowed most repair issues to be resolved locally, which meant shorter wait-times for students and staff to get their laptops back or wireless networks to be repaired. Having technicians on-site also allowed school-based personnel to track and prioritize repair issues based on the instructional needs. Finally, on-site technicians allowed the Technology Facilitator to focus on providing instructional support to the teachers instead of technical troubleshooting.

**Student Technology Teams.** Student technology teams are being coordinated by the Technology Facilitator at some 1:1 schools. Often these student volunteers are being trained by the Technology Facilitator and technician to support the 1:1 initiative. Student tech teams’ tasks include helping determine consequences for breaking rules related to inappropriate technology use, creating weekly news and sports broadcasts, and providing initial troubleshooting technical support to their teachers and peers. Some students receive service hour credit for their time spent on the student tech team. Student technology teams can provide a great, low-cost resource for a 1:1 initiative.

**Professional Development**

Teachers in the participating schools reported receiving professional development from several sources to support the laptop initiative. This professional development ranged from very general to very specific and targeted toward implementing a 1:1 learning environment. Specific recommendations emerged from teacher focus groups and surveys about the type of professional development that is essential for a successful 1:1 initiative.

- *Content-specific professional development* on the use of technology to enhance teaching and learning in each core discipline (math, science, social studies, and English/language arts). Teachers recommended that
this training introduce specific tools applicable to the subject area that prepare teachers to use technology to support project-based learning activities.

- **Hands-on activities** that provide opportunities for teachers to engage with the technology as learners themselves in order to help prepare them to incorporate the technology in their teaching. These activities should introduce basic technology skills as well as classroom uses of specific resources such as OneNote, SAS Curriculum Pathways, formative assessment tools, blogs, wikis, podcasts, digital video tools, GoogleEarth, Geometer’s Sketchpad, course management systems (e.g., Moodle, Blackboard), and content-specific, web-based resources.

- **Instructional strategies** to help teachers address students’ multiple learning styles with the laptops and create a paperless classroom.

- **Lesson planning sessions** that provide guidance and time to develop classroom activities that integrate curriculum content and technology. Teachers recommended that these sessions focus on real-world applications and enable teachers to work together.

- **Site visits** to 1:1 classrooms and interactions with teachers who have experience teaching in 1:1 learning environments.

- **Assessment with technology** including tools for planning, developing, creating, storing, and assessing e-portfolios.

- **Differentiated levels of professional development** to address teachers at different levels of fluency with technology and experience integrating technology into the curriculum.

- **Classroom management and policy issues** including acceptable use, student safety, cyber-bullying, copyright, laptop storage, battery charging, and technology to monitor student use.

- **Opportunities to interact and collaborate** with other teachers to share best practices, lessons learned, and effective resources for the use of laptops in given content areas, and with different students’ learning styles.

- **On-going support** through social networks that allow teachers to communicate with other 1:1 teachers in their subject area and share lessons, resources, and experiences.

- **More time to plan and practice** ways to implement dramatic changes to instructional practices and lessons.

Teachers expressed a need for planning time to build their technology skills with the new hardware and
software, locate resources, collaborate with other teachers to build cross-curricular lessons and projects, and create new lessons that effectively integrate technology.

• “Just-in-time” mentoring from the Technology Facilitator provides an important aspect of professional development.

School Leadership

Consistent, supportive, distributed leadership promotes adoption and buy-in from teachers and students for the 1:1 learning environment. Key characteristics emerged from the conversations with teachers at the 1:1 pilot schools for school leaders to successfully support a new 1:1 initiative. Principals should consider their role as it relates to each of the following recommendations:

A Leadership Framework for Technology Innovation Projects in Schools

Vision

• Articulate a vision, exhibit excitement and buy-in.
• Establish clear goals for the 1:1 initiative.
• Indicate that the initiative is not a passing fad.

Shared Decision-Making

• Provide a time for team problem solving.
• Include others in decision-making (e.g., goals, policies, measure student success).
• Request feedback from teachers on 1:1 initiative

Advocacy

• Leverage strategic partnerships to support the initiative.
• Convene stakeholders to contribute to the development of technology-infused strategic plans.
• Provide opportunities to showcase student work with stakeholders.

Infrastructure

• Secure or purchase needed resources (hardware, software, tech support, access to websites).
• Arrange schedules to allow for common planning time and group reflection.
• Establish flexible policies supportive to technology in the classroom.

Professional Development

• Encourage faculty to attend professional development.
• Provide training opportunities specific to teacher needs.
• Respond to requests for assistance.
• Monitor teacher integration during classroom visits.

Evaluation

• Use multiple sources of data for evaluating the impact of technology on student outcomes.
• Establish clearly defined criteria for assessing 1:1 laptop integration and teacher performance.

Communication

• Use technology to communicate with students and staff
• Promote the legal and ethical use of information and technology (e.g., respect for copyright, intellectual property).

Sustainability

Budget Planning. Careful short- and long-term budget planning is important to the success and sustainability of the 1:1 initiative. Many resources are needed to support the use of the computers, ranging from displays to printers to specialized equipment for science experiments to content-specific software. Decision makers need to plan budgets to include these resources and their immediate upkeep and support, as well as long-term costs of replacing hardware and supplies (e.g., expensive projector bulbs, ongoing software licenses, replacement of obsolete, damaged laptops, print toner cartridges, print paper, online textbook resources, additional batteries, rewiring/retrofitting old buildings).

Stakeholder Engagement. Engagement of key stakeholders can facilitate sustainability of the 1:1 initiative. It is important for schools to engage representatives from the school, district, college partners, business partners, and the community to help inform planning; guide decision-making; provide support to the students, teachers, staff and administrators; and support the sustainability of the 1:1 initiative.

Conclusion

These recommendations should be used to inform future work at a school or district considering implementing a new 1:1 initiative and will make the transition a bit easier for your teachers, students, and parents. At this point, you may be asking yourself, “Why go to all this trouble?” In schools, the reason is always – for the students. The students in this study were eager to utilize their laptops every day in every class; for increased access to engaging educational websites and digital resources and games; for study assistance; for more opportunities to
interact with their peers through group projects, collaborative lessons, and research projects; and for each teacher to have a website where students could go for announcements, links to course-specific websites, downloading presentations and notes, and submitting assignments. While long-term indicators of success remain to be seen, preliminary results suggest that 1:1 learning environments better prepare students for their futures in a globally-connected, technologically-supported world.

