



Learning is

Personal

Stories of Android Tablet Use in the 5th Grade

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learninguntethered.com

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Introduction

Over the past three to five years we have seen interest in mobile devices as learning tools grow exponentially. What was once a counterintuitive curiosity is now the subject of serious evaluation by an ever-increasing population of school districts, and yet there are still significant and contentious questions about mobile learning implementation that are being debated without much clear data or classroom-based experience. These questions include whether handheld and tablet form factors are adequate for student production of content, or just consumption and whether Android or iOS devices are more appropriate for school implementations.

The Learning Untethered project was created to help shed some light on questions like these through a very quick, low-cost, and light-weight process designed to provide anecdotal and suggestive evidence on these questions. The results are intended to inform such near-term decision-making as is unable to wait for the outcomes of formal research, and also to suggest areas that might benefit from formal research in the future.

Executive Summary

What happens when every student has his or her own personal, connected, mobile device for personal use and for learning? Are mobile devices appropriate tools for writing papers and creating content that conveys understanding, or are they best suited for consumption? Are Android devices a good alternative to the more expensive and popular iOS devices? How does teaching and learning change when every student has a connected, personal device?

These questions are the subject of debate within the field of educational technology and deep, broad understanding of them will require substantial, time-consuming, and expensive research of different instructional approaches and toolsets. Since the conclusive results of such efforts will not be available to education leaders making decisions about investing in these devices in the coming school year, Learning Untethered was conceived as a very quick, light-weight, nimble, informal, low-cost collaborative project to provide some experiential classroom evidence and insight around these questions to add to the conversation taking place about the use of these devices in schools. Thanks to new business models that make devices and connectivity more affordable than ever in the past and to the sweat equity contributions of everyone involved, this “guerilla research” project has yielded interesting outcomes at a cost of less than \$200 per student per year (by amortizing the cost of the device over three years).

Below are some of our conclusions, observations, and opinions:

- Surprisingly, the quality of student writing on 7-inch tablets and on netbooks was essentially equivalent. Student preferences, however, regarding which device to use for creating content varied. In general, though, students prefer to use laptops for large projects (e.g. content that requires substantial editing) and mobile devices for quick notes (e.g. content that requires essentially no editing at the time it is created).
- For the purposes of writing, mobile devices share many of the limitations of writing with pencil and paper – it is linear and cumbersome to edit, though fairly straightforward to create. Although mobile devices are great for capturing pictures, video, voice and even draft writing, laptops with their bigger screens and keyboards and mature software are at an advantage for editing and polishing large projects as well as at combining multiple media.
- Although Android devices have a number of desirable qualities, including a lower cost and an open ecosystem for apps, the relative immaturity of the Android ecosystem prevents us from being able to recommend Android devices for school implementations at this time.

“Thanks to new business models that make devices and connectivity more affordable than ever in the past and to the sweat equity contributions of everyone involved, this “guerilla research” project has yielded interesting outcomes at a cost of less than \$200 per student per year”

There is no guarantee of backward compatibility – that new apps will work on older devices. Though this is also beginning to be true in the iOS ecosystem, the problem there is much smaller as there are far fewer operational devices not running the most current version of iOS. Also, since the Android operating system, the hardware, the vendors, and the communications providers are separate organizations, there is no single organization responsible for the whole system as sold, making it cumbersome for educational institutions to manage successfully on their own.

- Some of the concerns discussed regarding the use of mobile devices for students strike us as red herrings. In practice, we found no need for device management software as students took ownership of their devices, their learning, and the management of their device images. We found students became savvy and safe Internet users when exposed to authentic Internet user experiences (though social networking happened only within a secure, teacher-managed platform). We found students quickly established a culture of responsible use of their devices, which seemed to enhance their learning rather than distracting them from it. We noticed students becoming confident (and successful) debuggers of hardware and software obstacles, turning first to each other for support and generally finding answers within their classroom community or online.

- We observed an organic shift in educators' approach to teaching, transitioning from primarily preparing and delivering content to the class to an environment where students independently seek out content and contribute it to ongoing classroom discussion. The outcome was a culture where the educator and students learned together, and from each other. We believe that two conditions were essential for this shift: first, that each student had his or her own, connected device that was used for personal purposes as well as for classroom learning; second, the classroom learning culture supported the students' individual freedom (and responsibility) to explore and experiment, permitting them to decide how to best use the devices to support their learning in the 5th grade.

- We found that students independently chose to use their devices in “snippets of time” for math, spelling, word games, reading, and other educational uses that matched their interest, level, and pace. In effect, the students essentially eliminated down time from their day while self-differentiating their learning.

- Over the course of the year, the students developed skills and habits in using the tools and resources available through their mobile devices. In their culminating project, a presentation of a colonial trade, the implications of those skills became apparent in project work that was significantly richer, more complex, and more sophisticated than that of students in prior years.

Project Description

☺☺ In every way, the project was structured for freedom. Personal devices with 24/7 Internet connectivity freed students from the traditional time and space limitations of learning in a traditional classroom. ☺☺



Project Description

Learning Untethered is not a formal research project, but rather a collaborative exploration that is possible only through the contributions of all the project stakeholders.

- Learning Untethered contributed a class set of 7” Samsung Galaxy Tabs running the Android 2.2 operating system, and mobile data plans with Internet filtering from Kajeet for Education.
- The district contributed new policies, processes, and IT support for the informal trial of connected, mobile devices in the classroom
- The principal contributed strong leadership support, a focus on evolving new instructional practice, parent communication and involvement, and a safe space for experimentation with new tools, ideas, and practices.
- The classroom educator performed the day-to-day implementation of the project, experimenting with new tools and practices, managing day-to-day technical issues, sharing expertise within virtual communities of practice, and collaborating with the students to change the classroom culture to one where students increasingly owned their own learning.
- The students [n=27] contributed to each other within their own classroom community of learning throughout the year, finding and sharing apps and resources; helping each other navigate and understand the Internet; debugging devices when the devices didn’t cooperate; and developing a shared standard for appropriate use of the devices at school.
- The parents monitored device and Internet usage at home and supported their children as they worked through through the frustrations of various device challenges.

The Learning Untethered project offered the students mobile broadband for any time, any place connectivity. Just a few years ago, the costs for a mobile device 1:1 program, when including data plans, could easily reach six figures per year. Modern iOS devices and recent data plans bring the price tag to a fraction of that, and a new offering from Kajeet for Education for Android devices can reduce that cost by half or more. Using Kajeet for Education, the program was able to purchase a “bucket” of bandwidth that students could share and use as they went, rather than purchasing an individualized plan where much of the available data goes unused. Students were able to learn any time, any place, in snippets of time or in long stretches according to their circumstances and needs thanks to the affordability of mobile data with Internet filtering for schools.

The project began the school year with students using the tablets with Wi-Fi access at school. A few weeks into the school year, we held a parent meeting to share information about how the devices were going to be used, what the parent role was when the tablets were used at home, and how Internet filtering worked. This last item was an important consideration because of how the devices can seamlessly use whatever kind of Internet connection becomes available. For example, while at school, the devices would be connected via the district's filtered Internet connection. When not connected via Wi-Fi (e.g., anywhere outside of the school) the devices used Kajeet's filtering service. But if the student's home had its own Internet connection, there was no guarantee that Internet filtering was enabled, which placed the burden of monitoring students' Internet usage at home on the parents. We also ensured that parents understood that even though these were learning devices, parents still would set the limits on how, when, and where the devices were used by their own children, just as they would if they had purchased the devices for personal use.

After this meeting, the students began taking the devices home. They had assignments and homework that would be completed using the devices (or other computers at home, if available) using cloud-based resources such as Spelling City, the class blog, and other on-line resources. The students performed their own device management, negotiating with parents regarding what applications they had permission to download and use at home, and working as a group to decide what applications were appropriate to use at school, then downloading and managing their own apps and device configurations.

In parallel with the classroom roll-out, the district worked to develop the policies and procedures that would support this new mobile 1:1 model, providing administrative support as the project progressed. As the program rolled out mobile broadband connectivity halfway through the school year, the district was prepared with parental-consent contracts and responsible-use requirements.

The project manager, principal, district IT director, and classroom teacher identified a set of guiding questions and themes to explore during the project. As the implementation evolved, we focused on those guiding themes, looking for anecdotal evidence that shaped our shared, informal working model of what mobile learning looks like in the 5th grade classroom. The list of guiding questions evolved with our implementation, but in the end a handful of key themes emerged:

“We were surprised by how small a difference there was in student work when using the tablets for writing vs. using the netbooks.”

- Are tablet devices, with their small screens and miniscule keyboards good enough to replace laptops for student content creation such as writing papers, creating presentations, etc?
- Are Android devices a viable alternative to the popular iOS devices for instructional use?
- Does student use of technology at home allow the teacher more face-to-face time at school for richer, more in-depth, or more complex learning activities?
- Are primary school students able to learn to behave as responsible citizens when given extensive Internet access?

Many of these areas produced results that were surprising in at least one respect:

- We were surprised by how small a difference there was in student work when using the tablets for writing vs. using the netbooks which were shared among the classrooms.
- We were disappointed that our expectations of being able to show evidence that Android devices can be effective for schools were not met.
- Although we were unsurprised that technology enabled a higher quality of student work both at home and at school, we were amazed at the degree of richness and complexity these young students demonstrated in their culminating projects as compared to students completing the same assignment in previous years.
- Students confirmed our expectations that they have the capacity to be responsible users of mobile devices with Internet access.

In every way, the project was structured for freedom. Personal devices with 24/7 Internet connectivity freed the students from traditional time and space limitations of learning in a traditional classroom. Permission to treat the devices as completely personal when outside the classroom freed students and families to apply the technology to their own purposes using the tools, apps, and habits that served them. Strong, supportive leadership from the principal freed the teacher to experiment freely in using the technology to best serve student learning. This approach led to a classroom philosophy of technology-supported self-directed learning, with students choosing the learning activities that appealed to them to fill moments of down time or transition.

Classroom Implementation

☺☺ Ultimately, every student's device became just as unique as each of them, and every student served as his or her own device manager. ☺☺



Classroom Implementation

The implementation in the classroom was characterized by three distinct phases. In the first 3-4 months, students became familiar with the devices, became comfortable with navigating the Internet appropriately, and ready to use the devices daily for learning and other personal interests. The middle 2-3 months were characterized by numerous technical challenges that complicated student use of the devices. With the technical problems largely addressed or accepted, the final three months saw the emergence of device-supported social learning culminating in unexpectedly rich final student projects.

The Early Months

The students began using their tablets within the first weeks of school. They were thrilled to have the opportunity to use this technology for learning – they called the tablets their “babies” and somberly discussed all the rules for taking great care of them. They also discussed classroom rules for using the tablets, including considerations such as not bragging or showing off to other classes who didn’t have the chance to have tablets of their own.

One of the first discoveries about the tablets was that, unfortunately, they came pre-loaded with applications that couldn’t be removed. Some of these were pretty clearly apps that families and educators would not have chosen for the kids, including game previews that not all families found suitable. Another was the Facebook app. This was the class’s first opportunity to discuss and engage with these authentic issues around digital citizenship. Exposure to the “real world” of the Internet came front and center in the form of the vendor’s enforced opinions regarding the tablet configuration, and the students quickly learned how to deal with inappropriate or unwanted content (in this case by shoving the undesired apps to a back page of the tablet UI). It also sparked family conversations about what was available on the devices and family policy for how they were used.

These lessons continued as students began downloading free apps only to discover the advertisements were intended for quite a different demographic (e.g. ads for on-line gambling and dating services). This led to further discussions regarding free vs. paid apps, the economics of advertising, and the trade-offs for consumers. Later in the year, as new students joined the class, the existing cohort was able to quickly explain the ins and outs of apps, content, and advertising to them, demonstrating not only a nuanced understanding, but a high level of comfort and familiarity with the practical everyday workings of the mobile Internet.

After some cursory explorations of available apps, we found that most became deeply engaged with gaming, music, and/or photo related apps. Some students began using the mobile device as a way of staying in touch with family – since they were allowed to use the devices nearly all the time at school, they could use e-mail to coordinate after-school logistics, to ask a parent to bring a forgotten item, or just say hello.

In the classroom, students kept their devices on their desks, always accessible at a moment's notice. Many of the uses of the tablets were student-initiated, such as taking and sharing notes during read-aloud time. Students developed the habit of looking up information whenever questions occurred to them during the day. This was in direct contrast to prior years where, when a question came up, the teacher would ask a student to go to the back of the room, boot up a computer to find the answer or alternatively to just write the question down on a sticky note to be addressed later if going to look it up seemed too disruptive. In this year's classroom, students would seek information in parallel with instruction or discussion and very quickly offer it to enrich the session.

Parents shared that this habit of seeking information and following their curiosity continued at home. In addition to using the device for information relevant to their own purposes, such as comparing various games, students began using the devices as part of family discussions and debates, seeking supporting evidence for their arguments or answering questions of fact.

Google Earth was a highly appreciated tool in the first few months as students read and discussed Theodore Taylor's, *The Cay*. Using Google Earth, the students "visited" Curacao and were able to get an authentic sense of the island that previous years' students had missed out on. The discussion and surprises and insights about the setting enriched the instructional unit significantly. As part of their literature circle discussions about the book, students looked up images of objects mentioned in the book that they had never seen before.

In the first several weeks of class, the teacher helped the students to download and use certain applications and showed them how to find and assess additional apps. Just as kids in this school are taught from the early grades how to choose a "just right" book, one that is not too hard, not too easy, and interesting, our 5th graders learned how to choose appropriate apps. They learned strategies such as reading reviews, reading the app descriptions, checking ratings, and so on. They learned that free apps are often buggy and come with ads, but that paid apps, of course, can be expensive and in the case of Android involved attaching a parent's Google wallet to the device. The students began choosing,

“Just as kids in this school are taught from the early grades how to choose a “just right” book, one that is not too hard, not too easy, and interesting, our 5th graders learned how to choose appropriate apps. They learned strategies such as reading reviews, reading the app descriptions, checking ratings, and so on.”

downloading, and using the apps that they themselves preferred for doing school work or engaging in other learning activities. Ultimately, every student's device became just as unique as each of them, and every student served as his or her own device manager.

The Middle Months

Toward the middle of the school year, problems with the tablets that had seemed rare and anecdotal in the beginning of the year started becoming frequent and widely observed. At the same time, two connectivity issues were frustrating students. The first issue was the result of the mobile broadband (3G) connectivity not yet having been activated. The software on the tablets assumed that the first thing a user would do was activate the device, but in our case this didn't happen for several months. As a result, every time the device was turned on it would go through a lengthy process of first determining that it needed to be activated and then asking the student to take those steps.

The second connectivity issue came from students using a public Wi-Fi access router at the school that required the students to accept the terms of use before Internet access was granted. Like the Wi-Fi available at public places and hotels, the students had to go into the browser to accept the terms of use before the device had Internet access. They had to do this every time they turned on the device, and often the connection would drop in the middle of a session. The student would just see that their web-based app had stopped working, then they would have to realize that they had lost Internet access, at which point they would have to go through a cumbersome process of launching the web browser, turning the device on and off, until the "accept terms of use" screen would come back, they could accept, and then be reconnected to the Internet.

Needless to say, the interaction of these two connectivity complications led to poor usability experiences for the students. Additionally, many of the devices demonstrated difficulty connecting to the district's Wi-Fi network at all on many occasions, even when right next to a router (and after accepting the terms of use in the web browser). The problems plagued the devices even when connecting to other Wi-Fi networks. Around this time, the students expressed profound disappointment with their devices and were deeply frustrated. According to our survey results, some were even willing to turn their "babies" over to another class for the second semester.

Unfortunately, we weren't able to resolve the causes of these technical challenges. Were they hardware problems? IP protocol stack problems? Software causing memory leaks, fragmentation or corruption due to a

lack of quality assurance screening? Operating system bugs? Hardware/software interactions? It could very well have been any combination of the above. In the absence of other information, we took a series of steps:

1. We received help from district IT to configure each device to use the private Wi-Fi network at school, removing the need to log in before accessing the Internet
2. We activated mobile data for the devices, eliminating the activation screen issues.
3. For those tablets that were still exhibiting “freezing” behavior, we reset them to original factory settings. Unfortunately this had the side effect of losing the students’ data - although the students moved their downloaded apps from the device to the mini SD card prior to doing this reset, many of them lost their configuration and related data (including progress in their games) in the process. This unexpected loss led many students to feel even more “down” on the devices.

Taken together, these steps significantly reduced the flakiness of the devices. Students became adept at recognizing when a new app seemed to cause bad behavior and would readily delete it. Students who became the “power-users”, using more apps in more ways, seemed to have the most trouble with their devices and got into the habit of giving up their stored data and resetting their devices to original factory settings periodically (even though this would require waiting for the next IT visit before getting their tablets reset to use the private network). For most students, most of the time, the devices became usable again.

Still, though, several times a week, a device would hang. Many of the students complained of the tablets still “freezing” and not becoming usable again for several hours, or even overnight. The failure mechanism was random and unrepeatably with specific devices, but common enough to be an issue with the whole set. Students worked around this to the best of their ability – fortunately most of them had at least some access to computers at home, and there were netbooks and a few MacBooks available in the classroom – but the ongoing frustration of never knowing for sure that their devices could be relied on contributed to an underlying, nagging, annoyance for the class.

We had wanted to see if these remaining issues could be addressed with an upgrade of the operating system, but unfortunately Samsung had elected to stop supporting these devices with any later versions of Android.

“The teacher and students gelled into a very functional learning community where they collaborated as peers, continually improving their collective mastery of all the facets of mobile learning.”

The Final Months

Even though the mid-year technology issues caused significant challenges and frustration for the class, there were several positive outcomes. The students were exposed to the real world pitfalls of working with leading-edge technology and became sophisticated in dealing with the obstacles. They supported each other in several ways: when they had tech problems, Internet questions, and were looking for new games, apps, and tools. The teacher and students gelled into a very functional learning community where they collaborated as peers, continually improving their collective mastery of all the facets of mobile learning. As the technology issues abated, this momentum carried into the last three months of the school year.

The introduction of Edmodo added a digital dimension to this learning community in the last part of the school year. Edmodo is a secure, closed, collaboration platform reminiscent of Facebook, but moderated and populated with student accounts created by classroom teachers. Although a few of the kids already used Facebook, all considered Edmodo “cooler” because, unlike Facebook, their friends were on it.

The class used Edmodo to create separate “groups” or “channels,” virtual workspaces that were used for different purposes. There were some generic channels, including one for all students to discuss schoolwork, reminders and class information posted by the teacher, another specifically for homework help, and a third social-oriented channel (the “playground”) where students could connect with each other for non-school related purposes. With Edmodo and mobile broadband, students could now access their school work, online content, and their learning community 24/7, as determined by each family’s policy on technology use at home (e.g. rules regarding no Internet devices in the bedrooms, or after bedtime).

Students also proposed new channels for their learning community in Edmodo. One example involved their pen pals from Japan. During the year, the students exchanged the traditional pen-and-paper letters, treats and gifts with their pen pals in Japan, but this only happened occasionally. The students were hoping to spend more time connecting and proposed creating an Edmodo group to connect the two geographically separated classrooms. With this online group, not only did the students communicate directly with their pen pals, but also were able to see others’ discussions within the channel and make serendipitous connections. For example, one student might connect with a friend of his/her pen pal’s, and the two might also start writing each other. The pen pals sent notes and shared pictures and video of their lives and homes in Japan. The students hoped to continue this connection beyond the end of the school year.

Homework was handled almost exclusively via Edmodo. Students would receive assignments digitally and return them the same way. Most often, there would be writing assignments posted online inviting students to comment on each other's work, in the spirit of peer critique such as that described in Ron Berger's *An Ethic of Excellence*.

With homework being digital, it was much easier for students who missed class to keep up. In the case of one student, who was out for a longer stretch of time, the teacher asked some of the other students to put together some videos regarding what was being covered in math and post them on Edmodo – a task the students easily handled independently. The students also appreciated the opportunity to be genuinely helpful within their learning community in this way.

In another situation, one student went on an extended vacation, causing him to miss making the presentation on a major class project. Knowing this, he recorded his speech, uploaded it to YouTube and sent the link to the class via Edmodo. The teacher's plan was to have the class comment and constructively critique each student's presentation, and this was no exception. The students simply made comments to the absent student's Edmodo post. In short order, the presentation was viewed and 25 comments were waiting.

The final project of the year, across all the 5th grade classes, was to research and report on a colonial trade. Students gave presentations in the character of colonial apprentices, including reading "letters home" to Europe they had written as those characters. In the past, students would research the information they needed using a few books and searching the Internet. This year, student learning was richer – they were able to gain a deeper insight into colonial times, synthesize information from a greater variety of sources, and present a more authentic picture of colonial life.

Before the culminating project, the students completed an in-depth unit on the Revolutionary War. As part of the experience, the students played the game, *Mission US: For Crown or Colony*, allowing them to simulate participating in everyday life as a 14-year-old apprentice, as it was in colonial Boston. After playing the game for 20 minutes twice weekly, the students would write as their trade apprentice in a diary. This diary was written out long hand, a change from the now largely digital writing experience that became predominant through the school year using the tablets. Once they had a final draft, students would use the microphone function of Evernote to read their entries aloud, enabling them to hear dropped phrases or confusing prose even though they had thought the written work was complete (a technique shown to improve writing skills and which they used often for their writing projects).

According to their teacher, “Being able to play the *Mission US: For Crown or Colony* game on the tablets was a huge benefit for students this year! Students could play the game at school or at home. Since they were asked to handwrite a summary of the day as the apprentice, note taking was very important. Students easily opened up Evernote when needing to remember and record specific information on the names of people they had met, the tasks they were required to do that day, or the important differences between the two sides of the war.”

Students read several novels set during the Revolutionary War, and an Edmodo channel for each novel was created as a place for students to communicate with each other while reading the assigned books. These groups became a valuable tool for organization, deeper understanding of the books, and assignment completion.

- **Organization:** Students improved their organizational skills by communicating and clarifying page numbers to be read, which assignments needed to be completed, when the meetings were scheduled, etc.
- **Deeper Understanding:** Edmodo served as a place to ask and respond to questions/confusions surrounding the reading. Rather than waiting until one of two weekly meetings (or even the next day), students were communicating with one another at home (where the reading mostly took place), working out confusing parts in the book together. Students, who were typically reticent to share their personal experiences and thoughts about the reading in class, became quite “vocal” in the online group. Students also found it fun to attach pictures of important or difficult vocabulary.
- **Assignment Completion:** Students were responsible for writing journal entries as the main character of the novel once during the week, incorporating important events, emotions and feelings experienced by the character during the week’s reading. All students were also required to respond to their peers’ journal entries as another character in the book, pushing each other to respond fully and thoughtfully. Reading the student responses, we strongly believe that these “conversations” led to a deeper understanding of the character’s choices, reactions, and relationships in the story. This writing ended up being very helpful to the students on the culminating project.

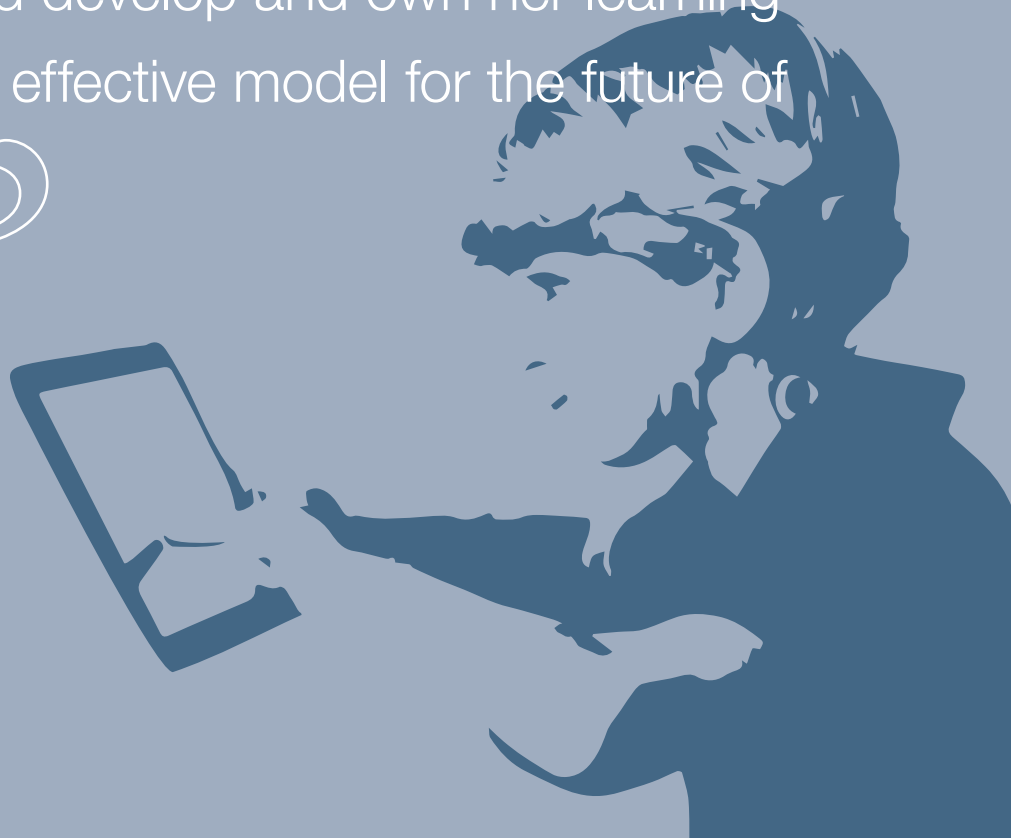
In prior years, students didn’t have the opportunity for collaborating on finding information and resources to the degree students did this year. Each previous year, students would be given a list of useful websites and then be sent off to pull the information they needed from those sites. This year they took a different approach. An Edmodo group was created for the project, and small groups were formed for each colonial trade. Once

there was a simple and organized way for students to share and post the great info they found, “they went wild!” Students were going out of their way to help other students by pointing them to great sources. A student could post on Edmodo that they couldn’t find info on the raw materials needed in blacksmithing, for example, and other students would rush to help them by linking to a site that offered the info. It was like a mini helpline, with some kids waiting on Edmodo to see whether anyone needed their help. Students across the grade level who were assigned to the same colonial trade were eager to connect up and collaborate with each other and support the huge task ahead of them.

This depth of work was made possible as a result of the collaboration and richness of resources made possible through connected mobile devices as well as the students’ attitudes and dispositions after a year of using them as independent learners. According to their teacher, “The end project seemed so real, it was as though they had actually experienced it – it was emotional, at times, with students really able to understand how political views of the time tore families apart. This had never been done so powerfully before.”

Results

☺☺ This project demonstrates that technology-rich environments, with personal devices for all students tailored to their preferences, and the freedom for every child to discover and develop and own her learning is a powerfully effective model for the future of education. ☺☺



“We have gained a new level of insight regarding the role of technology as an enabler that removes many of the obstacles learners face and how the distinctive qualities of each student — their strengths, preferences, habits, and dispositions— lead to unique manifestations of learning when supported by technology.”

Results

In this section, we share our observations and opinions on the themes that emerged as the project evolved. Our focus is on those things that surprised us or changed our thinking. The reality of implementing a 1:1 mobile program has reinforced many of our prior ideas as well as caused us to question some of our previous assumptions.

At the end of the day, all our experiences strongly underscore just how personal learning is for each student, in each class, in each school. It also illustrates how easy it is to generalize (incorrectly) about students and their use of technology for learning. We have gained a new level of insight regarding the role of technology as an enabler that removes many of the obstacles learners face and how the distinctive qualities of each student —their strengths, preferences, habits, and dispositions— lead to unique manifestations of learning when supported by technology. This project demonstrates that technology-rich environments, with personal devices for all students tailored to their preferences, and the freedom for every child to discover and develop and own her learning is a powerfully effective model for the future of education.

In addition to this overarching theme of personal devices for personalized learning, we have found interesting and sometimes counterintuitive results within each of the project’s key themes.

The Tablet Form Factor and Student Content Creation

One of the questions that set this project in motion was whether students were truly able to use a mobile device as their primary (or only) device for learning. Specifically, could students use mobile devices for content creation, not just content consumption? Mobile devices have significant and unique advantages as well as significant disadvantages, depending on the purposes to which they are put.

The results of the project suggest the advantages of mobile devices are:

- **Portability:** cell phones and tablets are easy to carry and therefore taken most any place the student goes.
- **Connectivity:** mobile devices with cellular data make ubiquitous connectivity a reality, letting students connect with their content and their learning communities any time and any place.
- **Battery Life:** cell phones and tablets work effectively on a full battery not only throughout the school day but also for several hours

after school, (though they require charging each night for this to be sustainable).

- Boot time: mobile devices are instant-on, not requiring the several-minute boot times of netbooks and laptops, particularly those laden with IT-ware of various kinds.
- Affordances: Multi-touch screens, GPS, and video/image/voice recording capabilities make mobile devices versatile inside and outside the classroom.

The project also found a few advantages of using laptop/desktop computers:

- Laptops and desktops have large screens supporting multiple windows making complex work much smoother than with smaller devices. Students can bring up multiple sources of information in multiple windows and easily reference them while collaboratively editing documents, creating videos, or communicating with peers.
- Laptops and desktops have the large keyboards that make the physical elements of writing easy and transparent allowing students to focus on their work rather than on the mechanics of typing and moving text around.
- Applications and tools for laptop/desktop computers are far more mature, full-featured, and usable than their mobile counterparts.

Ultimately the trade-off is between the always-available, personal device and the larger-sized stationary content creation device.

On the one hand, in previous implementations, most available information from students regarding whether mobile devices are adequate for content creation are not only anecdotal, but suspect. It is easy to find students who will swear that they are just as productive on smartphones as on laptops and who can show extensive work they have created using those devices. But we question whether that assurance is biased by other motivations that value the cell phone as a personal communications and gaming device so highly that the academic interests receive disingenuous praise.

On the other hand, those of us who have access to multiple devices can't imagine using a mobile device to write long papers, edit video, or develop complex spreadsheets. Still, we hear anecdotes of students texting with the phones still in their pockets and see well-written essays developed on smartphones and have to question whether our skills and habits are adequate guides for assessing technology use among students whose

skills and habits may be quite different. Maybe we are just too old and set in our ways to appreciate what students can accomplish with the smaller devices.

In the middle of the school year, we did a quick survey to examine this question. The students were asked to perform a typical short writing assignment to compare their performance on the two devices. The students were given a choice of five writing prompts from which to compose a one or two paragraph response. Half the students used tablets and the other half used netbooks. To minimize differences due to variations in word processing software, both groups composed their responses using Edmodo. After a short recess and a few laps around the schoolyard, the students returned to the classroom to choose a second prompt, and this time switched which device they used to composed their response.

Although the pieces written on the netbooks seemed to be slightly longer than those written on the tablets, we were surprised by how close they were and that the overall quality of the student work was essentially the same on both devices, as judged by the classroom teacher.

We also surveyed the students regarding their device preferences. For this particular assignment, 59% preferred using the netbook for writing as opposed to 41% who preferred the tablet. When asked if they could use any device for the writing assignment, 67% of students said they wanted to use a laptop, 15% would choose the tablet, 7% would select the netbook, and 11% indicated they'd prefer a pencil. We also asked them whether they felt their work was better quality on the netbook or on the tablet. Almost half (45%) felt it was about the same, while 33% thought they did better work on the tablet and 22% thought they did better work on the netbook.

These informal results contradicted a number of our expectations and raise several interesting ideas for further research. For instance, not all students loved using the mobile device regardless of its impracticalities. (Perhaps this was somewhat understandable given the technical challenges just being resolved at the time of our informal experiment.) Also unexpected was how similar the quality of work was from students using the two devices, which seems to imply that the writing process isn't impaired by using tablet devices.

Our impression is that we'd observe different results if the nature of the work was different, specifically for longer writing synthesis, where the work may be non-linear, involve multimedia, or involve a large amount of editing. In these cases, the advantages of desktop- or laptop-sized devices would likely be preferred. For this project however, we didn't

explore this, as it would have interfered too much with the instructional day. We are, however, very curious to see research that would bear out this assumption or, again, surprise us.

We were surprised by the variation in student preferences for which device to use for writing. As we asked students about this, we discovered that the form factor (mobile device vs. netbook) was secondary (by far) to the priority placed on the responsiveness of the device. In other words, given the choice between a slow laptop computer and a fast mobile device, the mobile device would be preferred even for tasks where the laptop would otherwise have an advantage. It seemed that only when given the choice between equally fast devices, did the length of the assignment take precedence over responsiveness in choosing which device to use. As expected, shorter writing assignments influenced a preference for the mobile devices, whereas longer writing assignments biased students towards laptops or desktops. For everything in between, student preferences varied significantly: Some students loved writing on the tablets because they could see the keys and their text at the same time without glancing up at a monitor, then down at their hands, while others liked how their hands fit comfortably on the netbook keyboards.

Although all students appreciated having a personal device of their own —one they didn't have to share— the type of device they prefer is not always the same. Perhaps contrary to the beliefs of the hardware vendors who sell these devices, it seems to us that one size certainly does not fit all and that by enforcing one single form factor (laptop, tablet, cell phone, or pencil), some students will be advantaged and others disadvantaged.

Android vs iOS

We had expected and, frankly, hoped to use our experiences as a proof point that Android devices could serve as an alternative to the popular iPad in schools. We had several reasons for wanting this to be the case:

- Android tablets are less costly than iPads.
- The business models that make mobile data more affordable are available for Android devices.
- Android allows the user to obtain apps from any source, not just a single source store.
- An open ecosystem is more likely to support the migration of student data and content between apps for personalized learning than a closed architecture that isolates the data of each app.

“ We discovered that the form factor (mobile device vs. netbook) was secondary (by far) to the priority placed on the responsiveness of the device. In other words, given the choice between a slow laptop computer and a fast mobile device, the mobile device would be preferred even for tasks where the laptop would otherwise have an advantage.”

- Students can create and share their own apps for Android tablets without approval from Google or the device manufacturer.
- Having already invested in Android tablets, it would be great for us if they were a good solution.

We were concerned about addressing a number of known iOS advantages:

- iOS applications purchasing for multiple devices is available (though convoluted and not without its own complications).
- iPads are perceived as being easier to use, with a smoother, more delightful user experience overall.
- The Apple App Store ensures a level of quality control on their applications so that bad apps don't adversely affect the operating system or other applications installed on their devices.

Android Suitability for Schools

Based on our specific experiences from the Learning Untethered project we aren't able to recommend Android devices for school implementations.

Although we found a number of advantages to using the Android devices that paralleled the features found in iOS devices, the fragmentation of the Android ecosystem combined with its relative immaturity means a higher degree of technical issues are likely to be encountered with no reliable way to address them yet. When different entities develop the operating system, build the devices, sell the devices, and sell the communications services, there is no single entity responsible for the resulting overall user experience with the mobile device.

In our case, when we had unexplained instabilities in the population of Galaxy Tablets, we wanted to update Android to the most recent version to see if it would help. Only then did we learn Samsung had chosen not to support newer versions of the OS on our device model. This is actually very understandable: Although Google builds and releases new versions of Android, every device manufacturer has to modify each version to work with each unique piece of hardware – if they support all versions of the OS on all devices, the maintenance costs increase by several orders of magnitude.

However, though to a perhaps lesser degree, this problem is now becoming evident with iOS devices as well, as apps requiring iOS 5 or later can no longer run on the original iPhone or iPhone 3G.

Another shortcoming of Android was the lack of enough high quality content-creation apps to effectively evaluate it for editing text or multi-media presentations.

Perhaps the two concerns are related, as it makes sense for developers to write new apps for only the most recent version of Android since it can be expensive to write multiple versions of an app, one for each previous iteration of Android. If app developers only want to write one version of their apps, that means their market is small – limited to the devices that are running the most recent version of Android – and so it's plausible fewer developers are incentivized to develop for the Android market.

What this means for schools is that once generic consumer devices like our Galaxy Tabs stop being supported for use with newer versions of Android, we will have to live with any instabilities and likely without access to many new apps.

Android Evolution

Despite our disappointing results, we still maintain optimism about the future of Android and the Android ecosystem:

- We saw an example of the rapid evolution and maturing of the Android space when using Google Docs. When we began our exploration, we tried using Google Docs but found the Android app nearly unusable. That changed overnight in March 2012 when we downloaded the latest version of the app that beautifully provided all the collaborative editing and writing features we had come to appreciate in the browser-based version used on laptops. We are excited about the potential for rapid maturation of key productivity and content-creation software for Android.
- We experimented with a newer Android device, the HTC Touch (built on Qualcomm's Snapdragon chip), which exhibited none of the Wi-Fi connectivity issues or instabilities we had seen in the Galaxy Tabs. We fully expect and hope to see more such always-on, always-connected devices that work seamlessly in the future.
- We appreciate the seamless integration of Android devices with Google apps and have confidence that those will remain available on Android devices for the foreseeable future. Also, we have high hopes

that these apps will continue to be supported on older versions of the OS as newer versions become available.

- We found that our concerns about device management were misplaced entirely once we empowered students to manage their tablets as if they were their own devices.
- We found that the tablet user experience was good enough for students to readily become fluent and fluid at using the devices for learning.
- In a bring your own device (BYOD) environment where every student manages his or her own device and different levels of device performance are expected, Android devices seem like good candidates.

Use of Instructional Minutes

One of the questions on our minds was whether and how personal devices in the hands of every student could improve teaching and instruction. We didn't specifically structure lesson plans or projects with the goal of changing how each day's instructional time was used, but we observed how instruction changed as an effect of natural shifts in the daily interactions of the students and teacher using mobile devices.

We found two ways in which the time of students and the teacher were more productive as a result of the technology: the first being when students made use of brief snippets of time between class activities, and the second being when students were spending time on more complex work.

As with many of the shifts we observed in the classroom, the shift to using snippets of time evolved fairly organically. Students had been introduced to a number of informal and formal learning games and apps (e.g. Words with Friends, Spelling City, IXL math, and Kindle e-reader) and had used these to reclaim time during class transitions. Typically as a class transitions from one activity to another, some students are ready immediately and wait several minutes for the whole class to be prepared. With their devices immediately available at their fingertips, those students began filling this "down" time with additional learning.

The shift to more complex work grew out of students' ubiquitous access to Internet resources and their homework and learning communities via Edmodo. This enabled them to read articles or watch videos, practice peer critique, and organize and share resources the students themselves discovered and used to further their own learning.

Students as Digital Citizens

One of the first questions we hear when suggesting that students should have the free use of personal devices in school is, “How can you trust kids with those devices?” When asked about it, we find people mean different things by that question, including:

- How do you keep kids from going to or accidentally seeing inappropriate content on the Internet?
- How do you keep kids from engaging in cyber-bullying?
- How do you keep kids from being distracted in class?
- How do you keep kids from damaging the devices?
- How do you keep kids from cheating on the test?

The answers to these questions about whether mobile devices are appropriate are entirely analogous to the answers to these more general questions:

- How do you keep kids from bringing inappropriate magazines to school?
- How do you keep kids from engaging in bullying?
- How do you keep kids from being distracted in class?
- How do you keep kids from damaging their textbooks and school property?
- How do you keep kids from cheating on the test?

In embarking on this project, we fully expected that the 5th grade students would live up to our expectations of digital citizenship just as they do now for their school community. We further expected that any problems in the digital world would be readily addressable in the same way problems on campus are – by using appropriate discipline and taking advantage of teachable moments, (something educators already know well). Those expectations were easily met in this project, and if anything, we underestimated the capacity of these young students to embrace a culture of digital responsibility in many dimensions.

That said, we have a few caveats and observations to offer:

- Although we are strongly biased in favor of giving students a great deal of freedom and expecting a great deal of responsibility in return, we set definite limits on students’ use of technology:
 - Students negotiated with their parents regarding how much filtering to place on their Google search results (we recommended the “medium” SafeSearch setting).
 - When using the school Wi-Fi or when using mobile broadband data, Internet access and use was filtered by the district or Kajeet.

“ We expected that any problems in the digital world would be readily addressable in the same way problems on campus are – by using appropriate discipline and taking advantage of teachable moments, (something educators already know well). Those expectations were easily met in this project.

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- Students negotiated with their parents regarding what their family considered appropriate apps and uses of the devices outside of school.
 - Students negotiated with each other and their teacher to decide what would be considered appropriate use of the devices at school.
 - Students were warned that if they lost or broke a device, it would not be replaced.
- Three of the devices ended up with cracked screens (one was badly cracked) and one was stolen from a parked car.
- Even though access and use of the Internet was filtered, sometimes students came across apps that were somewhat creepy. For instance, one of the free apps the students found displayed ads that were not targeted to 10-year-olds, such as ads for gambling, with illustrations of women who were dressed suggestively and others presenting pop-up notices that “Someone wants to be your boyfriend.” Though we would have preferred to avoid the experience entirely, the silver lining was that the students learned, experientially rather than by lecture, to:
 - show an adult whenever anything on the Internet made them uncomfortable;
 - be thoughtful in deconstructing advertising messages; and,
 - realize that strangers could reach them via the Internet and be thoughtful about providing personal information.
- As far as we could tell, these young students were more interested in knowing how to avoid inappropriate content than in how to circumvent filters and safeguards.
- Just as students are given freedom to move around the playground but not leave it, students were given the freedom to engage in social networking within the closed, secure system of Edmodo, but not outside it. They gained practice with developing their reputations and voice online in a safe, monitored space rather than learning those skills on Facebook where any mistakes in judgment become a permanent part of their record.

We found that young students can use their experiences with the mobile devices to become savvy digital citizens responsible for more of their own learning. We found that without complex and expensive device management software and with limited IT support, these students were more than capable of being responsible for their mobile devices. We found that with basic Internet filtering, they were able to use those resources responsibly in support of their learning and their own personal purposes. We found that with access to a secure collaboration platform they were able to begin developing smart social networking skills.

Our experiences suggest that the belief that student use of technology in school must be either banned or tightly controlled is likely unfounded.

Serendipitous Findings

The most interesting findings are often the unexpected ones – and so it was in this exploration. Though we are very interested in what has emerged regarding our key themes, we found two unexpected outcomes to be even more intriguing. The first was a seemingly organic shift from a classroom centered on directed instruction to a more collaborative classroom where the teacher and students work together as peers to explore the use of technology for learning. The second was the emergence of student agency and authentic self-directed learning. We believe the mobile devices facilitated these transitions, removing barriers to these kinds of teaching and learning environments.

Shifts in Practice

We propose the shift in her teaching practice over the school year stemmed from a conscious decision on the part of the classroom teacher to not be “the expert with the answers” about the mobile devices. Instead, she encouraged the students to Google answers, to help each other, and to share interesting tools, apps, and projects back to the class. This “push” helped shift the students to more independent learning and created a virtuous cycle of increased responsibility leading to increased mastery, which in turn, led to further increases in autonomy.

The “feel” of the classroom shifted noticeably to one where the teacher worked with the students as a co-learner rather than as the authoritative source of knowledge. This shift began with exploring technology, but expanded into other academic areas as students became accustomed to seeking out answers to their questions and really enjoyed the freedom of learning motivated by curiosity rather than the extrinsic and intangible motivation of “do good in school.”

Over the school year, the teacher was able to spend less time on teaching factual knowledge, which the students learned from multiple sources, and instead spent more time answering questions about root concepts, causal relationships and more abstract ideas that lacked definitive answers. This also freed up time to spend on creating an environment where independent student work was purposeful and meaningful and on coaching and guiding the students as learners.

Within the area of technology use, the teacher walked the students through establishing guidelines for evaluating whether an app was appropriate for school use. They learned together how to evaluate new

“Our experiences suggest that the belief that student use of technology in school must be either banned or tightly controlled is likely unfounded.”

apps for quality and to articulate why an app enhanced their learning (or distracted from it) in the classroom. By including the students in developing the guidelines for app selection, the students felt empowered to direct their own learning with the mobile devices. As they learned about new technologies or gained new insights in academic areas, the teacher was able to recognize and help students generalize this important critical thinking skill.

Setting the right boundaries together with students and reinforcing student skills and behaviors such as seeking information, collaborating, critiquing, and discussing work beyond the hours of the school day using digital tools, all seem to have contributed to a culture of active, engaged, independent learning and teaching.

Student Agency

This class of 5th graders exhibited what John Seely Brown describes as a “questing disposition.” They acted independently, with personal agency, to seek out knowledge and experiences that supported their formal and informal learning.

As adults, many of us are comfortable with not knowing answers to our questions. “Why is the sky blue? Oh, good question, I should look that up sometime.” The 5th graders who spent the year with a tablet are no longer content to passively wait for information. They follow their curiosity and seek answers and information the moment a question occurs to them, then share what they learn. We believe that two factors contributed to this shift.

First, the students came to think of the devices as personal, as *their* tools. They were not only allowed, but expected and encouraged, to use them for non-school purposes of their own. For many students this meant music, photos, and gaming. For some it meant connecting with their families during the school day.

As a result, the students became very skilled at finding new games or music. Many carried their devices everywhere, using them as resources during family arguments to find supporting data for their positions. The students didn’t think about these uses as “educational” – they certainly weren’t given any assignments to “find an opportunity to use your device to win an argument with your brother,” but they became comfortable using the Internet as an extension of the knowledge stored in their brains and a source of new experiences. They began to focus on marshaling their thoughts rather than recalling data. Over time, the skills and habits they applied in their own worlds began to become more complex.

Second, the students had the freedom to use their devices at will in school and with whatever tools they chose. The skills and habits developed at home moved into the classroom seamlessly as they applied the skills they had developed for their own purposes to the work of 5th graders. (At the same time, skills and habits developed for school were just as applicable to their personal pursuits.) If the students were curious about something described in a book, someone would immediately look it up and share the information with the class. If they were discussing a topic, they would find supporting information online. They gained the habit of following through on the questions prompted by their curiosity rather than tabling them for future research or asking someone, such as the teacher, for the answer.

The culture created by the classroom teacher encouraged exploration. She framed the journey toward using devices for learning as a shared experience and she modeled and expected the collaboration and sharing and continual learning that characterize good learning communities. The class embraced that approach, beginning with gaining confidence that they could find and contribute meaningful information and resources to the class. Soon the students became confident and self-motivating in choosing how to spend their time to enrich their learning. As the community moved on-line with Edmodo, students took more and more responsibility for answering each other's homework questions, critiquing each other's work, and helping the whole group keep up with the curriculum. The work of teaching and learning evolved for this class as the teacher and students worked, in many ways, as peers to explore the use of technology.

Recommendations

“ We believe that 21st century students need personal devices AND ready access to high quality, responsive desktops or laptops, but that if we have to choose between them, always-on, always-connected personal mobile devices provide the greater advantage.”



Results

School and District Recommendations

The perpetual question remains: what mobile devices should schools buy?

With respect to the question of mobile devices vs. laptops or desktops, our experiences reinforce our preferences for the mobile devices:

- We feel that tablets are a significant improvement over pencil and paper for creating content, though clearly not as large an improvement as laptops.
- While we feel that personal mobile devices are catalysts for self-directed “just-in-time” learning, laptops are a better choice for making the mechanics of writing and editing simple and efficient.
- We believe that 21st century students need personal devices AND ready access to high quality, responsive desktops or laptops, but that if we have to choose between them, always-on, always-connected personal mobile devices provide the greater advantage.

Ideally, every backpack would contain both, with the mobile device always out on the students’ desks and the laptop pulled out for more concentrated work.

We recognize that providing students with this level of technology (the same level that many of us enjoy and consider essential as professionals) is not always realistic. One way a school might achieve this is establishing a BYOD program to get as many personal devices into the classroom as possible, then bridge the gap with school-owned mobile devices, in addition to a computer lab for large project work. In our project, students were provided with tablets, and nearly all had access to laptops or desktops at home. The specific implementations will depend on the resources and needs of each building, district and community.

We caution districts and schools against purchasing low-powered devices, regardless of their form factor. Before purchasing a device, we suggest testing it with full IT-ware in a classroom to discover whether it is responsive to student needs in quickly finding and using Internet resources, in taking notes, in switching between contexts and applications, in playing education-related games, and so on. If the time from opening the screen to actual work is more than a few seconds, consider another device. If copying a link from an Internet browser into a document is more than 10-20 seconds work, consider another device. If games and apps “freeze” for several seconds at a time while the device processor catches up, again, consider a more powerful device.

Educator Recommendations

We found a number of practices to be helpful in creating a classroom environment that helped students use their technological freedom in constructive ways and in bringing the community of parents, educators, and students together in supporting the 5th graders' learning. Some of these include:

- Building a shared culture of responsible use:
 - Let parents know that they make the rules and set the consequences at home.
 - Develop criteria for evaluating apps that are “schoolappropriate”, or “approved for school” to get approval and keep the list on the wall
 - Establish rules for tablet use and consequences for not following them – include both parents and students - and follow through!
 - Negotiate how much time students can spend on tablets vs. going outside for recess.
- Streamlining logistics:
 - Require that all students charge their tablets at home before coming to class each day.
 - Buy Kindle books and create rules for how many books can be downloaded at once and take time to explore the features of the Kindle reading app.
 - Have a set place for keeping the tablets when they are not in use (top of desk, in backpacks, etc.).
 - Practice taking the tablets out and putting them away.
 - Put names on the tablet cases.
 - Have students store their passwords in a single place, such as Evernote, password protect that, and share their password with both parents and teacher.
- Building a collaborative culture of shared learning:
 - Build in time to learn together – implementing mobile devices will take more time than one might expect.
 - Give students time to explore and personalize their devices.
 - Take time in class to discuss any issues that come up, check in with students and debrief often.
 - Make students the expert problem solvers, by creating a tech club or group for them to share their expertise and interest.
 - Share your learning with parents, administrators, and other educators regularly.
 - Use Twitter with the kids and connect with authors and other classrooms ... we tweeted with Neil Gaiman!
 - Learn to test and research apps – there are lots of duds and a few gems – then model those skills with students and other educators.
 - Step back from providing answers and become a “guide on the side”, and let the students help each other instead.
 - Show students early on how to use key features such as bookmarking and notetaking.

“We believe that specific offerings from industry would reduce the challenges of implementing mobile technology use in the classroom.”

There were a handful of apps that were used by the entire class:

- Evernote
- Words with Friends
- Edmodo
- Google Earth

There were also a handful of websites the entire class bookmarked:

- Class blog
- Spelling City
- IXL
- DoGo News

Industry Recommendations

We believe that specific offerings from industry would reduce the challenges of implementing mobile technology use in the classroom:

Android

It is our hope and expectation that over time the Android ecosystem will mature to the point where it is a robust alternative to the iOS ecosystem. Until that time, a specific education-focused offering could bridge the gap with the following features:

- A single point of contact for a limited suite of devices to address all technical problems from hardware/software/OS instabilities through user errors
- Insurance against theft, loss, and breakage
- Guaranteed support for new versions of the Android operating system for the same suite of devices
- Quality assurance for a set of education-related and content-creation apps, assuring that they will work well on specific devices
- Consolidated app purchasing that allows a school to purchase a set of apps to be shared among groups of devices, including student-owned devices
- Classroom management APIs to enable apps to automatically organize/distribute data amongst a pre-defined group of users, such as those working on a group project or entire class of students.

iOS

With iOS devices currently being the most ready for the classroom, we would like to see them be affordably usable for 24/7 connectivity, including:

- Business model support for mobile data at the same lower costs that are currently available for Android devices.

- Easy, consolidated app purchasing that allow a school to more readily purchase a set of apps to be shared among arbitrarily large groups of devices, including student-owned devices.
- Classroom management APIs to enable apps to automatically organize/distribute data amongst a pre-defined group of users, such as those working on a group project or entire class of students.

Device Form-Factors and Affordances

We would like to see continued research and development into devices that provide the immediate access and portability of mobile devices as well as the ease of content and multi-media editing of laptop devices. Perhaps such devices could eventually serve the role of both laptop and mobile device in student learning?

Research Recommendations

We find that our experiences raise more questions than they answer. There are many areas where we are anxious to see more robust research conducted:

- We attribute the shift to student agency and ownership in their learning to two factors: having a personal, connected device for both personal and educational purposes and also a culture that enables experimentation at every level. Are these attributions accurate? What are the necessary and sufficient conditions to engender this shift, and what are its implications?
- We consider tablet devices to be better than pencil and paper for writing, but believe larger computers are necessary for intensive editing and multi-media work:
 - What are the differences in student outcomes for large or multi-media content creation projects if they have ubiquitous access to a laptop vs. only occasional access?
 - How do these outcomes differ if the student also has 24/7 access to a personal mobile device for linear writing and capturing multi-media?
 - How much access (hours) and flexibility of access (any-time, any-place) will students require to laptops or desktops to effectively take advantage of the tools for content production that let them focus more on higher order work than the mechanics of editing?
- We found that even young students, like professional adults, have strong preferences for the devices and technology they would like to use for specific purposes. To what degree is a given student disadvantaged in the outcomes of his work if he is restricted to using technology that does not align with his preferences?

- We support students becoming savvy Internet users through authentic exposure to the Internet and supervised authentic use of social networking within an academic environment. How do the achievements of students using this “learning by doing” approach with real audiences and experiences compare to students being “protected” from the Internet through strong filtering and device lock-down? How do these different approaches play out for students as they enter adulthood?
- We found that device form factor is secondary to device responsiveness when it came to students’ day-to-day work. How does device responsiveness affect the quality of student work? What other factors might be at play here?
- If students have both tablets and laptops readily available, what usage patterns emerge? How large is the variation among student preferences as measured by their actual usage as opposed to informal self-report surveys?

About the Authors



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Bio

Marie Bjerede is a writer, speaker, and citizen advocate for education transformation. She believes people acting as independent agents can collaborate to get more done and live happier lives. She's seen, first-hand, how technology co-evolves with that model. She thinks a lot about how students, citizens, and employees can take ownership of their work and create force multipliers for productivity, creativity, and happiness. Marie has spent a quarter century in the wireless communication industry working in many roles - from embedded software coder to leadership geek to education advocate. From this front-row seat to the wireless revolution, she's seen mobile broadband bring the transformative potential of the Internet to industries and communities, but she's also watched as schools have been left behind. With her wireless communication background, she's now challenging technical, economic, social, and systemic obstacles to bringing personalized education to every student.

Reflections

It's not about the device.

As I began exploring the appropriate use of wireless technology for education several years ago, I was a telecomm executive and repeatedly heard this reaction. At the time, there was considerable cynicism regarding educational technology and appropriately so. Over the previous decade, there had been a vision that computer-based learning could promise personalization in learning and, in the minds of many, even replace teachers in many ways. Technology "infusions" that began with great optimism ended with computers gathering dust in the corners of classrooms as teaching and learning continued unaffected.

In hindsight, these failures were inevitable. The craft of professional educators lies in connecting with each student, not in the content delivery that technology provides so readily. There is a world of difference between a recorded lecture of a teacher and that same teacher engaged in a discussion with a student or a class. Any model where engineers who develop computer learning first subscribe to learning as passively

accepting content and reproducing it at will, and then prescribe ways of teaching that are necessary for the software to “work right”, is doomed to irrelevance. When edtech discussions devolved into desktops vs. laptops vs. mobiles, the focus on specific technology ignored these underlying structural problems. Awareness of this fallacy prompted the wide discussion about how technology was not a silver bullet and educational transformation was about pedagogy, not devices.

And yet, this project represents the second time that I have seen something amazing happen with the right devices in the hands of teachers and learners (and I’ve read and heard about more such results though not witnessed them first hand). Several years ago, Project K-Nect (<http://www.projectknect.org/>) in North Carolina provided at-risk high school students with mobile phones and software for learning math. I’ve written about the details elsewhere, but what I find most interesting was the shift in teaching and learning that happened.

In Project K-Nect, most students had never before had Internet connectivity at home. They were rural students who spent a great part of their day on the bus going to and from school. With the mobile devices, they were able to use a secure collaboration environment to communicate about math and were given some incentives to participate, whether just asking a question, answering a question, or sharing some work. At first the questions were simple variations of “I don’t get this problem,” yet within hours other students jumped in and started to help. Over time, the students created a community of learning where students who otherwise might not ever do homework would actually complete it, and students who normally would complete homework would have the additional experience of explaining it to others. These kids have consistently shown tremendous improvement in math, many finishing AP Calculus.

Were these results because of the device? Not exactly. The device removed barriers for the teachers and students who were the ones who did the work. The teachers experimented with the use of the device and made serendipitous discoveries. They found that, when connected, peers helping each other learn outside the school day have a profound effect on learning. They found that communicating by text included many students who normally would be too shy to speak up. Students who were ill became able to continue to participate remotely from home or a hospital. Students who normally would not enjoy much social status became stars as technology and math experts. The shift in learning that occurred as students created a learning community, helping each other, combined with open experimentation in the classroom led to a shift in teaching that was much more authentic, more problem and project based, and more effective. The shift was organic, not planned, and based in a virtuous cycle of collaboration, increased capability, and success between educator and students.

“The devices plus the freedom plus the vision of professional educators is the formula, not the specific practices that arise from these implementations.”

Learning Untethered saw a similar shift with a very different age group of students and yet it occurred in a very different way. In this project the shift began as students using the devices for their own purposes at home, and for learning purposes in their own way, became independent learners who no longer passively waited to be fed content. It reached a new level when students began collaborating on-line as well. Again, the device didn't cause this to happen, but it was a necessary tool that removed obstacles to authentic teaching and learning.

It would be easy to look at these and other successful mobile learning programs and miss the point, to, in effect, “look at the finger and not the moon.” It would be easy to ask others to use the same collaboration software or the same incentives for participation. It would be easy to implement “best practices” for structuring literature circles with mobile devices. It would be easy to train students to use devices during instruction in the way these 5th graders did autonomously. That would be a mistake, I think.

Although the specific structures and uses of mobile devices that are effective are very valuable to share and learn from, I believe the shifts in practice that drive independent learning and student agency arise when educators and students have the freedom to experiment and take ownership of their teaching and learning, and when personal, connected, mobile devices are freely available 24/7 to reduce the barriers that impede educators from teaching in the way they would like. The devices plus the freedom plus the vision of professional educators is the formula, not the specific practices that arise from these implementations.

That said, the question of how to evolve and scale these results is less about how to package up “best practices” from one implementation and force its adoption in another, and more about creating systems that create and sustain environments that support both access to technology and the freedom to take ownership of teaching and learning. This will require ways of recognizing and articulating excellent work by educators and authentic work by students that go far beyond the simplistic, reductionist, and flawed methods of merely measuring student test scores. It will call for recognizing both work with students and classrooms as well as work with peers inside the building and across the globe within communities of professional practice.

If we value student curiosity, agency, and independent learning as much as we do content and procedural knowledge then what matters, of course, is excellent teaching. Where technology can amplify and enable excellent teachers, it serves as a catalyst and even, in some ways, a silver bullet if it removes enough obstacles to allow excellent teachers to teach as they would like (though it should never be mistaken for a cure for indifferent teaching). In other words, although it truly is not about the device...still, sometimes it is.

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Bio

Tzaddi Bondi, fresh out of college, began producing content for two major online-community websites, TalkCity.com and CollegeClub.com. From there she decided to get closer to her passion, teaching. Serendipitously, her first teaching job took her to Japan, where she taught English to junior high students. Two years later, she was in her own classroom for the very first time, teaching 5th grade at an international school. It was there that she first got to experience the excitement of introducing the world of technology to her coworkers and students. Her students blogged daily, and for the first time, they wrote for a world-wide audience. After 5 years of living abroad, Tzaddi was ready to come back home. She is now living in Portland, OR and in her sixth year of teaching 5th grade at Stafford Primary. Tzaddi loves teaching students to become digital citizens and owners of their own learning. Every year looks different in her class, as technology changes and grows, and the students come in more tech savvy. This is what keeps Tzaddi up at night.

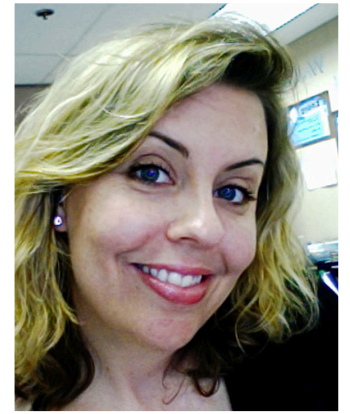
Reflections

My teaching changed.

When we took on this tablet project together, I knew just as much (or little) as the students did. We didn't know what apps were out there for the Galaxy Tab, we didn't know what the buttons did at the bottom of the screen, and we didn't know yet how much our daily learning could be supported by having 1:1, 24/7 technology. We did know that we were incredibly lucky to be chosen for this project and that we had an incredible tool at our fingertips.

I noticed the very day I handed out the tablets to the students, that my being the deliverer of information and the solver of problems was not sustainable, nor wanted. There was a very conscious moment when I decided that I could not be the only one to find the perfect tools, troubleshoot all the issues, and be the know-it-all.

Day one, I had a line of 20-something students at my desk wondering how to change their wallpaper, how to get online, how to set up their email, and how to take pictures. Inside, I thought, what the heck have I gotten myself into? Complete chaos! I told the students that I didn't have all the answers, that they knew just as much I as I did ... so they had better get exploring! This opportunity, the leveling of the playing field,



created an environment where students weren't able to give up as easily and come find me for the answers. They were stuck with their questions and problems, and they needed to push their curiosities in unique ways to find solutions. This was the beginning of a new-found sense of responsibility where the students had to take charge of their own learning, whether it be by troubleshooting, searching the Internet, or talking to peers.

Looking around the room at the sheer intensity of discovery and problem solving was incredible. I felt so proud of my students. It gave me a huge boost of hope for the coming year. The students were okay taking on challenges. They were okay guiding their own learning. They were okay being frustrated and lost. They were more than okay, they were thrilled ... and they were splitting at the seams to impart their knowledge to the rest of us.

I immediately had a sign up sheet for students to teach the rest of the class (and me!) what they found and how to do certain tasks on the tablet. After the initial how-to's, the sharing turned to apps. Any apps that were used during school hours needed to be approved, so students were eager to find, research, test, and then share useful apps.

Students shared note-taking apps, reminder/calendar apps, journaling apps, spell-checking apps, educational game apps, and more. It was up to the individual student which of the presented apps they would download for their own use. Any game apps were voted on by the students, whether or not they were "schoolappropriate" and should make our list of approved educational games anchor chart. Some apps were such a hit, that I asked all students to download them. One such app was the journaling app, Catch. Students were asked to keep a creative journal of their winter holiday break. Using Catch, students were able to type their journals, record their voices, take pictures or video... a multitude of options to be creative in how they shared their vacation with us. It made for some fun sharing when we all came back.

It was apparent that students love to create and document. Students became incredibly savvy at writing, filming, and editing video, which resulted in a lunchtime showing of their movie. Some students took pictures of their artwork, how neat their desk was, pages from a textbook so they didn't have to carry them home, or important notes off the board. Some videotaped excellent presentations to use as a model when practicing at home, a few students enjoyed creating "tutoring videos" of math lessons for students who were home sick, and others recorded the plays and music videos they made up during recesses. Using Evernote, many students made voice recordings of their partner poetry readings, they conducted interviews, and practiced reading aloud for expression and fluency while in the comfort of their rooms. The students came up with all of these uses on their own, and all of these creations and documentations could be shared digitally, allowing collaboration to

happen at anytime and anyplace, not just at school and not just between 8:00-2:30.

For me, one of the biggest realizations with the tablets was that I was able to connect with my students on a deeper, more individual level. Like all teachers, I think about my students even after they go home for the day. There have been so many instances where I wish that I had connected with a student more during the day, letting them know that I have been noticing their hard work or to thank them for helping me out at recess, or even to remind them to check in with me the next day about their latest read. I always felt frustrated about not having expressed everything I wanted to, should have or needed to. The beauty of each student having their own device and at-home connectivity is that I could relay anything I needed to at any time, not feeling like I had missed an opportunity.

I began to send my students direct messages on Edmodo or by email. It was awesome! It felt so good being able to personally acknowledge them and to let them know that I had noticed their work without the time constraints and the craziness of the school day. Sending these special, personal messages was easy and took no time at all. The replies I received, both on Edmodo and in person, let me know that these messages were a huge boost to the students.

The students were also connecting with each other more, making our class community stronger once students became reachable outside the classroom. I had no idea how much the class community could grow with the ability to extend our relationships and connections outside the school day. What a gift that has been, both for me as a teacher and for the students.

The thought of not having 1:1, 24/7 devices next year would be unbearable. How could I go back to the way things were? So much was gained by the students using and having connected devices at school and at home. Students learned so much more because they pushed their own learning, they sought out answers and that created more questions. The students learned how to manage frustrating situations by taking steps to finding a solution. They worked together with their peers the way we see in the business world, effectively and respectfully.

The students' drive for connecting, creating, and collaborating after the school day was over was perhaps the most inspiring thing to see. What the kids did in class and during recesses was extending into what they spent time working on and engaged in at home. Students became extremely helpful to each other, monitoring where the need was and pitching in.

To lose all of this possibility would, in essence, not be teaching in the best way I know how.

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