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Almost a decade ago, one of us (Mark) wrote an article in Educational Leadership titled “Going One-to-One.”1 At the time, early adopters in their school districts were beginning to experiment with one-to-one laptop programs, but the potential benefits of these ambitious efforts were speculative. What have we learned since then?

What Does Research Say?

One-to-one laptop or tablet initiatives have become more widespread, and research has begun to find evidence of benefits. A synthesis of 57 studies of one-to-one laptop programs from 2001 to 2013 found that these programs moderately improved math, science, reading, writing, and language arts test scores, with the strongest results for writing and mathematics (Zheng & Warschauer, 2013). In some cases, improvement started slowly as teachers and students learned to integrate the unfamiliar devices into the curriculum.

Various studies have documented specific benefits of one-to-one programs. Research suggests that students in such programs write better and revise more (Russell, Bebell, & Higgins, 2004); write in a wider variety of genres for more authentic audiences (Warschauer, 2009); engage in more student-centered and project-based learning (Cavanaugh, Dawson, & Ritzhaupt, 2011; Corn, Tagsold, & Patel, 2012); and experience more individualized learning (Zheng & Warschauer, 2013). Even relationships between teachers and students, and between home and school, improve (Lei & Zhao, 2008).
So what’s the bad news? The digital devices are not always used, let alone used effectively to support high-quality curriculum and pedagogy. Some initiatives focus on the technology instead of the content (see “Advice from the Trenches,” p. 64). One-to-one initiatives that are implemented without careful thought can be a distraction and a waste of valuable money, time, and energy—all of which are at a premium in K–12 education today.

Here, we draw from research done by others—as well as our own case-study research on one-to-one programs with laptops, netbooks, tablets, and handheld devices from 2003 to 2010—to consider how schools can increase the odds that a one-to-one program is not an expensive add-on, but an integral part of the curriculum.

**Which Device Should We Choose?**

Laptops—and especially their low-cost variant, the Chromebook—are an excellent option for districts that plan to use their devices for writing, research, and online activity. Chromebooks access web-based applications and storage rather than locally installed applications. This is a disadvantage for districts that rely on Windows- or Mac-based software. However, much instructional software can readily be replaced by online materials for teaching and learning math, science, social studies, and language arts—and productivity software such as Microsoft Office is easily replaced by cloud-based options such as Google Apps for Education. In addition to the Chromebooks’ initial low cost, they also require less updating of individual devices and allow improved sharing of devices because any device can log onto each user’s specific web-based applications.

iPads are also a popular option because of their light weight, high-resolution touch screens, orientational flexibility, multitude of apps, and capacity for taking pictures and videos. iPads are not as good for writing as laptops, but they are better for reading and interacting with texts. Because of their advantages for reading, iPads make the most sense for districts that are ready to move to a completely digital curriculum—for example, by eliminating textbooks. Beyond that, the intuitive touch-screen interface of iPads makes them an excellent choice for younger students and those with special needs.

Bring Your Own Device, or BYOD, is the least expensive option, but it’s also the least reliable, and it requires the most teacher flexibility and troubleshooting ability. In addition, some provision must be made for students who are unable to bring a device to school. BYOD probably works best in districts where most parents have the means to provide devices and where students and teachers are tech-savvy.

Districts should choose devices to correspond with curricular goals. Whatever device they choose, districts will want to start their programs small—in a few schools or a single grade level—and then build up from there, drawing from research done by others—as well as our own case-study research on one-to-one programs with laptops, netbooks, tablets, and handheld devices from 2003 to 2010—to consider how schools can increase the odds that a one-to-one program is not an expensive add-on, but an integral part of the curriculum.

A decade of experience and research offers some important lessons about what makes one-to-one programs work.

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on input from teachers, students, parents, and support staff about the lessons they’ve learned.

**How to Leverage Learning**

In the best schools today, digital devices are not used for short-term novelty, but rather to extend and amplify strong pedagogy and curriculum. A decade of research in K–12 schools suggests that one-to-one programs are most valuable when they focus on four key areas—content, composition, construction, and community (Warschauer, 2011).

**Content**

One-to-one programs can significantly enhance the quality and depth of content available to teachers and students. Students who have access to digital devices can engage in what researchers call just-in-time learning—obtaining information right when it’s needed. Authentic questions come up throughout the school day, perhaps sparked by students’ personal experiences or by recent events. Digital devices can enable students to immediately find the answers. In addition, students can directly analyze real data, perhaps by looking at information online about their own communities or gathering data from digital probes and microscopes related to temperature, voltage, light, force, motion, and chemical structure.

For example, a class may be learning about the continent of Africa, and students may ask about a recent conflict that has been in the news. The teacher can pull up appropriate articles or show on Google Maps where the conflict is occurring. A student fascinated by a recent red tide at the local beach can research the causes of red tide, read about local and worldwide efforts to deal with ocean pollution, and even e-mail or video chat with scientists.

Teachers can use digital devices to promote learning that is individualized (according to learning pace); differentiated (according to learning preferences); and personalized (according to learners’ specific interests).

- **Individualized.** Having access to his or her own device—for example, using a tutorial program in math or reading—can enable each student to move as quickly or slowly as needed.
- **Differentiated.** Teachers can provide support materials in multiple modalities, such as written text, video explanations, and games that explore concepts, and also give students flexibility in their own content creation. Students can interpret a poem by composing music to it, or analyze a book by photographing scenes that illustrate its contents.
- **Personalized.** Access to online resources enables students to find and use specialized information in areas that catch their interest, no matter how unusual or specific those areas are. For example, when studying the Roman Empire, different students might conduct research projects on areas as diverse as Roman architecture, the rise of Christianity, the life of Hannibal, or the Stoic philosophers.

**Composition**

Learning how to compose and edit on digital devices can increase students’ communication, language, and critical-analysis skills—all of which are important requirements for today’s workforce. And because most writing in college and the workforce is now done on computers, it makes sense for students to practice writing in this mode.

One-to-one programs make it easier to harness social media to support written composition. Online environments provide an opportunity for writing in diverse genres, to diverse audiences, on interest-driven topics, without geographic constraints. Online writing communities can support student writers by offering substantive feedback, along with an authentic audience (Ito et al., 2008). For example, the Young Writers Project (http://youngwritersproject.org) provides a medium for students to share their poetry, fiction, and non-fiction on a variety of contemporary topics with other students and to participate in writing challenges refereed by experts.
Construction
In the age of digital media, written texts are not the only important medium of communication. Rather, digital devices can be used to create a wide range of finished products, enabling students to interpret ideas and content and communicate their analysis across different modalities (Warschauer, 2006).

For example, students in a literature class can interpret the mood of an essay or play by creating an image to accompany it. They can advertise a novel that they’ve read by creating a trailer for a film based on the book, a task that requires them to synthesize the novel’s themes. Or they can interpret a Shakespeare play through an online newspaper, with events, sports, business, and comics sections all interpreting or commenting on material from the play.

Multimedia projects also support analysis and communication skills, such as persuasion. For example, middle school students can find and critique advertisements for unhealthy products and develop their own multimedia posters that include examples of those advertisements and counterbalance them with factual information. Students can also produce their own persuasive presentations—for example, explaining why a particular city (or planet) is a good candidate to host the Olympics.

Community
Digital media—online discussion forums, social networking sites, bookmarking sites, annotation tools, blogs, and wikis—can bring students together with one another, with peers in other classes and schools, and with adult mentors.

One-to-one devices provide abundant opportunities for students to connect with mentors or specialists. These connections are sometimes one-time interactions—for example, students in California using tablet computers and Skype to talk with a U.S. soldier in the Middle East and get a firsthand account of his experiences. At other times, the connections may be long-term, formal mentoring relations. For example, a popular book author might agree to comment on the short stories that students post on their class blog.

Youth can also connect with peers outside their own geographic community around areas of interest. For example, in the 524 Project, students in Washington, D.C., and Detroit, Michigan, filmed themselves performing poems and scenes and then came together in real time each week for a short “live exchange” in which they watched one another’s performances and learned more about one another’s worlds. Global connections also provide powerful learning experiences because they require learners to take a fresh look at their own culture when attempting to explain it to people in other cultures.

A Student View
The Potential of Stop-Motion Animations

It’s a good idea to use mobile technology in school, but the school should provide it and not rely on students to bring their own devices. When I had a dumb phone, I felt abandoned when we did assignments involving smartphones. Teachers often say that if you don’t have a device you should team up with someone who has one, but it’s difficult to share a small screen between two people. Sharing an iPad would work better.

Just this past weekend, my friend and I used mobile technology to make a claydoh stop-motion animation video for English. (You can see it at www.youtube.com/watch?v=2_qtcb6Aywo.) We’re studying the kinds of techniques that advertising companies use to create commercials. Our assignment was to create a short commercial using three advertising techniques of our choice among those we had discussed. My friend and I decided to do a stop-motion animation, and we had a ton of fun planning and carrying out our project. We were definitely more engaged with this project than with a worksheet, for instance, which you just fill out and don’t really care about. We learned more about advertising techniques because we saw how they work in real life.

Any subject area could have students apply what they’re learning by creating stop-motion animations. In history, students could create animations to describe some historical period, including significant figures and events. In chemistry and biology, students could create an animation that outlines safety procedures in the lab. Students could use these animations as a study tool. Creating stop-motion animations is a fun way for students to learn and reinforce their understanding of key concepts.

—Sarah Smith, 11th grade, South Lakes High School, Reston, Virginia
Putting It All Together
The one-to-one program at King Middle School in Portland, Maine, exemplifies how such programs can promote deep content, composition, construction, and community (Warschauer, 2006, 2011). King—which serves the most ethnically, linguistically, and economically diverse population of any school in Maine—has reorganized instruction around the Expeditionary Learning model. Supported by their individual access to laptop computers, students carry out most of their academic work through 8-week to 12-week, interdisciplinary, collaborative research projects called learning expeditions.2

Advice from the Trenches
High-quality implementations of one-to-one technology have some common themes:

**Tie the technology to curriculum and learning.** Education outcomes and goals must drive decisions about everything, from device choice to number of devices per student to software to professional development. Understand the learning benefits you are seeking, and center your implementation process around them.

**Expect road bumps.** Build in enough time, money, and personnel to deal with the inevitable issues that will arise during technology implementation. Although you can’t foresee every problem, assume that some problems will arise. Leaving space in your schedule and your budget will allow you to deal with the issues in a thoughtful manner, without negatively affecting the overall project.

**Have more infrastructure than you think you will need.** Early adopters were often taken by surprise by the amount of bandwidth needed. In some respects, strong rollouts are a victim of their own success. Make sure you have a sufficient pipeline for data and enough access points to accommodate increased demand.

**Resist the urge to micromanage**—whether staff, teachers, or students. When we create explicit rules about what students can do online, they tend to find the loopholes. Instead, try to establish global rules that apply to technology and nontechnology. Thus, discourteous online communication would fall under the preexisting school behavioral guideline about showing respect for others.

**Strike a balance between control and freedom.** Think carefully about what types of restrictions you need to put on device usage. If the security is too strong, it can make it very difficult for students to use the device at home, and students without the technological and social resources to find other options will be frustrated. In addition, to the extent you can allow students to personalize their devices, the students will use them more and take better care of them.

**Use the wisdom of those who went before you.** Edutopia, the International Society for Technology in Education (ISTE), Commonsense Media, and many others have tools, checklists, and resources you can use as a starting point.

**Communicate with stakeholders early, often, and transparently, but don’t let a few people derail your efforts.** Focus on moving forward with the majority. You’ll never please everyone.

**Give teachers time to plan together.** Let them watch one another work. Seeing technology in action is the best way for them to picture themselves using the devices in their own classrooms.

**Celebrate successes.** One-to-one implementations are a lot of work. Make sure to celebrate along the way. In the end, you are all working together to improve student learning.
audiences beyond the classroom. The approach seeks to develop students’ critical-thinking and problem-solving skills to prepare them for success in college and beyond. The school also emphasizes building strong adult-student relationships and positive character. Learning exhibitions give students the opportunity to try on different professional roles and work closely with adult mentors, both in person and online.

Students in an expedition create a comprehensive final product that requires each learner to demonstrate the targeted knowledge and skills. All student writing done for the final product goes through an extensive review process, including self-editing, peer editing, teacher editing, and multiple revisions; this process gives low-performing students numerous opportunities to improve their work and teaches all students the often-neglected process of iterative editing. The final product is multitiered so that students who need extra support to produce their required portion can receive it while more advanced students take on additional research, editing, or production responsibilities.

Extensive use of technology for research, writing, and multimedia production—especially individual student laptops and online resources, but also digital cameras, camcorders, and a small number of desktop computers equipped with specialized software—helps ensure that students develop technological skills to complement their academic ones. Finally, culminating presentations enable students to showcase their work to family members and the community.

In one recent exhibition, students interviewed Maine residents who had been active in the civil rights movement, conducted research from primary documents of the era, and collectively wrote a 200-page book titled Small Acts of Courage.

A video describing this expedition and showing the moving culminating event is available at https://vimeo.com/48803088.

In another recent exhibition, King partnered with university biologists to help students collect soil samples from local farms and analyze the bacteria they contained. Working with community graphic artists, each student produced a pamphlet about a particular bacterium.

In a third expedition, called Creating Currents, students investigated ways to reduce their carbon footprint. They conducted energy audits by collecting and analyzing data. They also investigated alternative energy production and public policy decisions involving alternative energy; and they collaborated with experts in the areas of conservation, building products, design, and alternative energy to create a green building design. The expedition culminated with a competition in which students built electricity-generating wind turbines.

Increasing the Odds of Success

Digital technology in education is here to stay. It’s no longer a question of whether to allow digital devices, but rather which devices—and more important, how to implement them. As more schools adopt one-to-one programs, we can increase the odds of successful implementation by focusing on content, construction, composition, and community. No matter what we do, our 21st century learners are bound to teach all of us a thing or two over the next decade.

References


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