The Mobile Learning Phenomenon In Education
Accelerating the delivery of personalized learning
The Mobile Learning Phenomenon In Education

Education is the most important investment one can make to prepare for the future. It unlocks human potential, equips people with the knowledge to thrive and enables them to achieve their aspirations...However, no education system can remain static. The world is changing rapidly. Technology is changing our lives. The skills needed in the future will be very different from those needed today. Education offers each individual and nation the best chance of navigating an unknown future—coping with uncertainty, adapting to evolving conditions and learning how to learn.

–Lee Hsien Long (Rizvi, Donnelly, & Barber, 2012, p. 3)

As education evolves, so does the way we teach and learn. This report focuses on one of the newest trends, still in its nascent stages—mobile learning. It describes the potential benefits of mobile learning, addresses the challenges and opportunities that introducing mobile learning presents, and provides examples from school districts that have already implemented mobile learning programs so we can learn from their best practices. The report also suggests key points to consider as you develop your plans, align your goals, and make decisions regarding mobile learning in your schools.

The Big Picture

The world of mobility is exploding. “Mobile is ramping up faster than any platform before it and will bring a staggering scale worldwide.” (Fendelman, 2009, Meeker quote) It is pervasive in most sectors around the world. Mobile devices are everywhere, from farms in rural Africa to corporations in Manhattan. Currently there are nearly 5.4 billion mobile phones. Silicon India reports that the number of phones will exceed the world population size in 2014. There are 2.4 billion new Internet users since 2000. Last year alone tablet ownership by United States students grew 257%. (IBIS Capital 2013, p.7) Staggering statistics to be sure.

But what concerns us in this report is what the impact of this burgeoning mobility world is having on education, specifically teaching and learning. And what should educators consider as they grow their own mobile learning programs?

...mobile learning is more than just using a mobile device to access content and communicate with others – it is about the mobility of the learner.

What Exactly is Mobile Learning?

“Mobile learning can be many things to different groups of people. Superficially, it appears from the outside to be learning via mobile devices such as smartphones, MP3 players, laptops and tablets. Certainly, these are important in enabling mobile learning.” (Belshaw, 2012)

Though mobile learning has been described as “any sort of learning that happens when the learner is not at a fixed, pre-determined location,” (O’Malley et al., 2003, p. 6) we must also include connectivity, which is implicit in today’s definition of mobile learning. The network connection transforms a mobile device from being merely portable to being capable of providing on-demand, ubiquitous access to content and communication tools. In “The Future of Mobile Learning,” author Rick Oller explains, “Portions of life once considered inaccessible to learning due to lack of network connectivity are now potential learning opportunities for the mobile learner.” (Oller, 2012, p. 1)

“It presents unique attributes compared to conventional e-learning: personal, portable, collaborative, interactive, contextual and situated, it emphasizes "just-in-time-learning" as instruction can be delivered anywhere and at anytime through it. Moreover, it is an aid to formal and informal learning and thus holds enormous potential to transform the delivery of education and training.” (UNESCO, http://www.unesco.org/new/en/unesco/themes/icts/m4ed/)
E-learning supports a traditional instructional model. Here, students learn in a set location at a set time and often receive more information than they are able to remember or comprehend; but extra information is provided just in case it’s needed later. Mobile learning or M-Learning is “personalized, learner-centered, situated, collaborative, ubiquitous, and contextual.” (Andrews, Haythornthwaite, Sage Publications, & Sage eReference (Online service), 2007, p. 223) Mobile learning is dynamic, letting the learner control the content to be just enough information just in time.

<table>
<thead>
<tr>
<th>E-Learning</th>
<th>M-Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicating with email</td>
<td>Instant messaging</td>
</tr>
<tr>
<td>Lecture in classroom, synchronous</td>
<td>Lecture capture technology, learning can be synchronous or asynchronous</td>
</tr>
<tr>
<td>Fixed location, plugged in</td>
<td>No geographic boundaries</td>
</tr>
<tr>
<td>Collecting and analyzing data in a classroom or lab</td>
<td>Collecting and analyzing data in the field</td>
</tr>
<tr>
<td>Tethered</td>
<td>Untethered</td>
</tr>
<tr>
<td>More formal, paced, structured delivery</td>
<td>Less formal, self-paced, on-demand</td>
</tr>
</tbody>
</table>

Examining the Impact of Mobile Devices

Mobile technologies are changing the ways in which we teach and learn, access and distribution information, communicate and collaborate. Having achieved exponential growth among consumers (by the end of 2013, there will be more mobile devices on Earth than people), mobile devices are firmly entrenched in our everyday lives, providing immediate access to content at our fingertips—informal, on-the-go learning. It is not surprising that mobile devices are now reshaping the education landscape. ("Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012–2017 [Visual Networking Index (VN)] - Cisco Systems," 2013)

Mobile learning experts Norris and Soloway predict that by 2015 every child in every classroom in every school in the United States will be using a mobile learning device (such as smartphone, mobile tablet) 24/7 for curricular purposes. (Norris & Soloway, 2013)

“Mobile learning is a hot topic right now, with great expectations from advocates that mobile devices could transform education, engage students and personalize learning.”

— (Grunwald Associates LLC, 2013, p. 1)

The scope of mobile learning is vast but this report will focus on the impact of the use of smart phones, tablets, and laptop computers in education. But let’s step back a moment. Will mobile learning do what its proponents say and put learning properly in the hands of the students? In the following pages, we’ll explore the ways in which mobile devices and mobile learning platforms have influenced teaching and learning and discuss the impact of mobile technologies on IT, administration, and security, and conclude with near term and longer range predictions about the future of mobile learning.
The mobile learning enthusiasts are talking about the untethered possibilities for connected learning, student engagement, personalizing learning, immediacy of collaboration, and anywhere/anytime access to information. They’re saying that schools will save money on technology by taking advantage of the tools that students are already using and save space when they give up computer labs. The technical people are talking about building more robust infrastructures to provide sufficient wireless access in the school and at a distance. Policy makers are talking about ways to ensure equity when mobile devices are not uniformly distributed in the population, ways to ensure student safety on the Internet, and ways to avoid inappropriate uses of these small devices during the school day.

But are enough people are talking about what kind of learning is actually taking place and how that matches up with what we want students to learn? Although mobile devices are being adopted at a rapid pace, it is import to align their adoption with learning goals both at the local level and with major learning initiatives such as the new Common Core Standards. And how are districts addressing professional development to ensure teachers are comfortable and effective in using and managing the use of mobile devices?

There’s a rich history of adopting innovative technologies in education. In this report we will reflect on the best practices of the past that can be applied to this age of mobilism and highlight issues to consider when implementing these new teaching and learning models. We will look at mobile technology’s relevant trends, examine the accomplishments of education’s early adopters, and discuss the barriers to adoption that educators face.

Elements of Mobile Learning

According to the NMC Horizon Report, mobile devices, mobile apps, and tablet computing will become mainstream (largely in use in 20% or more of institutions) in education within the next year, as will the use of collaborative environments and cloud computing. So what are these mobile learning devices?

The universe of mobile technologies is changing rapidly.

As we look at the trends in Mobile Learning, we focus on the smartphones, tablets, and laptops—the three most pervasive of the mobile devices emerging in K-12 and higher education institutions.

**Smartphones**, especially the iPhone and Android have redefined what we mean by mobile computing, and in the past three to four years, the small, often simple, low cost software extensions to these devices—apps—have become a hotbed of development.

**Tablets** provide even more capability for enhancing teaching and learning. Mobile apps designed for tablets have given many traditional print-based publications a new life, and new tools, such as iBook Author and iTunes U, are making it very easy for anyone to create and publish media-rich interactive pieces. The newest version of iBook is optimized for viewing interactive textbooks, and e-readers for the Kindle and Android platforms are heading the same direction. (Johnson, Adams, & Haywood, The NMC Horizon Report: 2012 K-12 Edition, 2012, p. 11) Tablets are forcing a transformation in the way we interact with our technology and digital information.

“High-resolution screens allow users of tablets, such as the iPad and Galaxy, to easily share content, images, and video. They are engaging and viewed as less disruptive than other hand-held devices (no phone ringing and no incoming text messages). Because tablets are able to tap into all the advantages that mobile apps bring to smaller devices but in a larger format, schools are seeing them not just as affordable solutions for one-to-one learning, but also as feature-rich tools for all sorts of assignments as well, often replacing far more expensive and cumbersome devices and equipment.” (Johnson, Adams, & Haywood, The NMC Horizon Report: 2012 K-12 Edition, 2012, p. 4)
Laptops, running the same applications as desktop computers and tablets or smartphones, are cost-effective bridge devices.

**Apps** are a fast-growing segment of the mobile arena.

**Mobile initiatives** and the demand for constant connectivity are driving the need for infrastructure upgrades.

Laptops are the bridge devices. They act like the desktop computer yet they are portable, can connect anytime, anywhere. They run the same applications as the desktop but many have the functionality to run apps like a tablet or smartphone.

Laptops are also more cost effective than their bigger desktops. “The electricity costs of a single computer may appear to be trivial, but the cumulative cost of electricity for all computers in a school can be substantial. Desktop computers consume substantially more electricity than do laptops.” (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2010, p. 2)


As mobile devices become more integrated in classrooms, educators and students are looking for new ways to apply them to the learning process. Applications on all of these devices can help automate current classroom processes or present new ways to learn that previously had been unexplored. (Zwang, 2011) Yet the explosion of the number of apps that are deemed to be educational poses an immense evaluation challenge to ensure they are pedagogically sound to integrate into the curriculum.

Apps in particular are the fastest growing dimension of the mobile space in the K–12 sector right now, with impacts on virtually every aspect of informal life, and increasingly, potential in almost every academic discipline.

**Infrastructure** – The growth of mobile initiatives, digital learning and data streaming, as well as the demand for constant Internet connectivity, are driving educational institutions to modernize and upgrade their network infrastructures. Eighty-nine percent of districts are upgrading their networks to prepare for digital content growth and 76 percent are upgrading network capacity to support bring-your-own-device (BYOD) initiatives. (Center for Digital Education, 2012, pp. 6–7)
Historical Context

As mobile devices have become increasingly popular the newest technology entries in a long history of technology in education. Even before computers, teachers used a variety of technology-based learning aids such as filmstrips, educational movies, and language labs.

Talking specifically about computer technology, the 40-year history includes computer-based drill and practice, interactive simulations, productivity tools, assistive devices, online courses, and portable devices. The goals included engaging learners, improving skills, and increasing students’ understanding. But unfortunately merely having these technologies did not mean they were effectively leveraged to improve teaching and learning. For the most part, the technologies were integrated into the existing pedagogy. Nothing really changed in how instruction was delivered.

But there is another unique difference in the early adoption of computers and this move to mobile devices. In the former, computers were not in the homes. In fact, many students saw them for the first time in schools. The integration of computers into education was driven by the schools. The goal, as today, was to integrate technology to improve student achievement.

The mobile movement comes from outside the schools.

But today the move to mobile learning comes from the opposite direction – the homes. Mobile devices are found in most homes in the country. The vast majority of children at all grade levels – preschool through 12th grade – have access to an array of technology at home, including mobile devices and computers. But the number and type of devices owned differs depending on students’ grade level and household income. (Grunwald 2013, p.5)

In addition:

- 5,000 new apps are published each week onto the smartphone marketplaces
- More smartphones are now being purchased than PC’s (Mckendrick, 2012)
- More time is spent using apps on a mobile device than is spent “surfing” the web (Gahran, 2012)

Indeed, we are moving at bullet train speed into the Age of Mobilism. (Norris & Soloway, 2013, p. 2)

Successful integration starts with a vision and a plan.

But what’s important about any of these technology-based tools whether they emanated from the school or the home is how they’re integrated into the instructional program. This requires

- A vision and a commitment by all stakeholders (educators, community members, and parents)
- A plan that articulates the vision
- Clear teaching and learning goals
- Tools that are simple to use
- High quality content aligned with relevant standards
- Teacher preparation and on-going support (both technical and instructional)
- Strong leadership
- Device availability
- A realistic timeframe
## Understanding Barriers

Understanding the barriers and their solutions that pioneering technology using educators faced is vital since many of those barriers exist today. They include cost, insufficient support, access, security, reluctance to change on the part of teachers, and lack of appropriate tools and software.

<table>
<thead>
<tr>
<th>Cost was a barrier.</th>
<th>Despite the advent of newer, smaller devices, technology is expensive when it’s purchased in school-sized quantities. The cost of providing enough infrastructure, hardware, and maintenance has always been a problem. And sometimes these purchases exhausted the budget before schools purchased the software and training they needed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient tech support and security were barriers.</td>
<td>Who’s going to manage the technology at the classroom and school level? When the network is down or the software doesn’t work, teachers don’t have time to troubleshoot and fix the problem. Insufficient technical support made many teachers wary of depending on educational technologies. And with every technology advance comes increased needs. One of the biggest needs when considering multiple mobile devices is having someone on site to troubleshoot these devices and solutions in a timely manner. Security is a huge worry at many levels. With today’s complex technology, it’s even more important to know what levels of security are needed and available on each device. And when data is stored on a network, security issues include protecting privacy while providing appropriate levels of access to students, teachers, administrators, and parents.</td>
</tr>
<tr>
<td>Lack of teacher acceptance was a barrier.</td>
<td>General teacher acceptance has rarely matched the fervor of the technology enthusiasts. Teachers need time to learn what they themselves can do with the technology as well as how it can help their students. Ongoing professional development, which goes a long way to addressing that issue, is critical. More than ever, teachers are responsible for students’ learning—as measured by their test performance. If they’re not currently using mobile devices in the classroom, what will make them start? What’s available to make their work easier or more effective? One can’t underestimate how important having sufficient professional development is to the success of a mobile learning initiative.</td>
</tr>
<tr>
<td>Lack of content was a barrier.</td>
<td>In the early days, it was hard to find appropriate content software because there wasn’t much, or it didn’t fit with the curriculum. Technology enthusiasts taught around the problem using generic tools, but this was difficult for most teachers. What seemed to help jump start the program was to provide tools that could be used across the curriculum with templates that could be modified for use in different subject areas. Today, there are ubiquitous platforms that can host multiple digital content resources, cloud-based software – tools, content and assessment, collaboration tools, social media, lecture capture tools and learning analytics that provide personalized information about each student’s performance to inform instruction. But as in the past there’s still the need for evaluation to ensure that students will have access to high quality resources that will help them meet their goals.</td>
</tr>
</tbody>
</table>
Many of yesterday’s barriers remain today.

If not solved with careful, thoughtful planning, many of the barriers of the past may plague the implementation of mobile learning in schools: cost, tech support, security, teacher acceptance, and lack of appropriate software.

Today’s schools have additional challenges.

| Cost of devices | Funding: The national Educational Technology Plan for K-12 recommends that schools provide 24/7 access to the Internet. However, it doesn’t provide direct funding. Schools are left to their own resources to find long term, sustainable funding sources. |
| Pace of technology change | Device costs are lower, but the pace of technology change is increasing. Schools must plan for funding new technology and rapid obsolescence. Even if students are allowed to bring their own devices, the costs for common applications for ease of use in the classroom plus support costs for multiple devices can all strain the technology budgets. Other new costs to consider are for infrastructure, wireless costs, cloud-based storage costs and sufficient bandwidth to support all the networked devices. |
| Support for device variety | Support - When schools furnished computer labs, they could standardize software and hardware. Unless they provide a standard set of devices, they will need to address device variety and software incompatibilities—an increasing issue with the Bring Your Own Device (BYOD) trend. The good news is that BYOD helps address the cost issue of buying devices but it raises compatibility issues that must be addressed with additional IT resources. |
| Concerns about acceptable use and student safety | Security - Teachers and parents are concerned about safety when students are allowed unfettered access to the Internet. Although students’ mobile devices often enable such access, some don’t. Some schools are talking about creating ‘safe environments’ for their students to work in. And educators concerned about the appropriate use of mobile devices are broadening their technology use policies to address this. |

The Common Core State Standards, adopted by most states, outline learning goals for each grade and in several curricular areas. Educators are currently working to meld their specific district practices with these standards. Districts are purchasing large amounts of tablets that can be used for the online assessments designed to measure how well students are meeting these standards.

Districts, associations, and teachers are developing activities that can be used on the tablets for students to work in the classroom or at home. The challenge is to develop curriculum that integrates the appropriate use of these mobile devices and digital content that can be used to meet the standards. Teachers will then need time and training to use these new combinations effectively.
Some challenges remain the same: It’s difficult to set goals and measure success for the use of educational technology. There’s never enough money. Professional development is underfunded. Teachers’ time is already oversubscribed. Administrative support is even more critical today as teachers will be evaluated on how this implementation helps improve student achievement.

It’s not enough to say “information is all around us” if what’s out there doesn’t relate to the issue at hand. Students have to learn to ask the appropriate questions in order to get relevant answers. As Grunwald points out, most high school students think mobile devices are for entertainment and communications. Teaching them how to use devices for learning is not intuitive. These are new digital skills that need to be taught starting in the early grades.

Parents play a much more active role in the advent of mobile learning in that they often are the purchasers of the devices. Therefore, they have more interest and knowledge in how they are used and their impact. Grunwald and Associates, recently completed a survey about their knowledge and perceptions of this growing phenomenon. The insights gleaned from this report should be heeded by schools. If parents are part of the conversation about implementing a mobile learning program, they are more likely to be positive and supportive in making it successful.

The parents’ perception is that schools are approaching a tipping point in their acceptance of and readiness to productively use mobile devices for learning. They believe that the use of these devices open up learning opportunities, benefit students’ learning and engage students in the classroom. But they also believe and embrace the use of these same devices at home where they can help the student with homework, research, projects, etc. (Grunwald, 2013, p.14)

Asking questions

There have always been enthusiasts who are doing good work with technology in education. The trick is to understand how to move from the success of the early adopters to success in the general population, as Geoffrey Moore so aptly describes in Crossing the Chasm. Here are some important questions to ask before plunging into any new technology:

- What is your vision for education?
- What are your teaching and learning goals?
- How can mobile solutions help you achieve those goals?
- How will you measure success?
- What are the various roles on your team who will support the process?
Teaching and Learning with Mobile Devices

“Mobile technologies enable students to go directly to all manner of information, people, places, data, events and locations; the
teacher (or the classroom textbook) no longer is the mediator. (Norris & Soloway, 2013. p3)

Despite the excitement among many educators regarding mobile learning—that using laptops, smart phones, and tablets could significantly change the way students learn—these mobile devices should not automatically be viewed as a panacea for education. As we have learned with other educational innovations, the success of their adoption depends primarily on how well each one aligns with the goals for their use and how comfortable teachers are with its use.

So the first question that must be answered by anyone considering the integration of mobile learning devices into the classroom is ‘what is your goal for using mobile devices?’ Do you want to improve student achievement? How will you measure this? Once you have a goal and a way to measure success, how will you train teachers to effectively use mobile learning devices? How can administrators help you achieve your goals?

Strategic advantages of mobile learning devices

Through a review of literature, interviews with educators, and observations of students, the top four advantages that the mobile learning devices offer are opportunities for:

- Student engagement
- Access to expertise—teachers, mentors, content
- Collaboration
- Personalization

1. Student engagement

One of the biggest concerns that schools have is the rising rate of student dropouts and the consequent dropping graduation rates. Many students do not find school relevant, interesting, or useful in pursuing their own life goals. They are not engaged.

These millennials, who use technology throughout their time outside of school, are cut off from these tools as they enter the schools. How can schools take advantage of the tools that students use to connect to the world in order to achieve academic goals?
Consider these possible scenarios:

**Mobile devices (MLDs) can help struggling readers.**

At the elementary schools, students use tablets with applications that reinforce core skills taught by teachers such as reading and math. In language arts, for example, students might use a mobile phone or tablet to listen to an engaging story, record it themselves as they read it aloud, re-record it until they are pleased with its accuracy. They can share these recordings with family members at home, add their comments, and share back in the classroom this montage. Later they can write about the key theme of the story using word-processing. With these mobile learning devices they can practice the key skills of reading, writing, listening, and speaking. This helps remediate the struggling reader in engaging ways. Students at higher skill levels can work in the same way with more challenging material.

**MLDs are great tools for project-based learning.**

Or, students can participate in project-based learning by using the mobile technology to document the shadows cast by a meter stick by taking digital photos and noting measurements, then creating a graph. Or they can create their own vodcast news magazine, going on virtual field trips, etc.

**MLDs help in research and presentations.**

Middle school and high school students use tablets and mobile phones to look up answers to probing questions teachers pose. They look for examples of core concepts in their own worlds, and then use laptops to integrate them in writing or presentations to share with their peers and teachers. In essence, these students are engaged in ways they have never been before. They too can consult with experts in their area of interest.

Other options include the use of polling tools, integration with interactive whiteboards, back channeling, guided use of social media tools (like Twitter or Audioboo). Or, what about interactive textbooks that are optimized for touch technology, tablets in particular? The possibilities are endless.

2. **Access to expertise—teachers, mentors, content**

The Internet has profoundly expanded our access to information. With easy-to-use mobile devices, students are increasingly taking advantage of that access—both in and outside of school.

**Best Practice: Bonneville Joint School District, Idaho Falls, ID**

[http://www3.d93.k12.id.us](http://www3.d93.k12.id.us)

The district provides online speech therapy support for over 500 students. Using their mobile devices, they collaborate with a speech therapist to help improve their language skills, which also impacts their reading performance. Students can practice anywhere with access to a live resource.

Students in rural areas, typically restricted by their locations, can now communicate freely with experts in other geographies. For students who are struggling, whether due to language, disabilities, or any other barriers to learning, mobile learning devices make it easier to find information, help, and expertise. These tools democratize learning opportunities by providing access to expertise and content.
3. Collaboration

For years, K–12 teachers have used collaboration to enhance learning. Students have worked in classroom teams, across classrooms, and even across countries. College students have experienced learning through collaboration in classes that employed the case study method. Study groups collaborated to solve questions posed by professors thereby learning not only from the teacher but each other as they pooled their knowledge, challenged each other’s positions about topics, and negotiated final theories.

With mobile devices and social media, collaboration is easier to achieve. The ubiquity of devices means more students can be involved, and the net can be spread wider in terms of finding partners and sharing results.

Another great advantage of social media is that it facilitates educators’ professional communication. Educators also use social media to get beyond the classroom door, collaborate with their peers in professional learning communities (PLCs), and find and become mentors. This kind of familiarity with social media can make them more likely to accept its eventual classroom use.

The growing use of social media in education settings reflects its increased use in our society.

According to a 2011 survey of 416,000 K-12 students, parents, and educators, it is not only students who have incorporated social media tools in their personal lives, but their parents, teachers, and administrators are active users of social tools as well. (Project Tomorrow, 2012)

Social media facilitates communities of practice as students collaborate with students, teachers with teachers, and students with teachers.

In higher education, students use social networks to form learning communities.

The role of social networking tools for academic purposes in higher education is nuanced. In a 2012 study of undergraduates, 67% of the students said that “technology helps them feel connected to what’s going on at the institution,” and the majority (59%) said it made them feel more connected to their instructors and to other students (58%). Researcher Eden Dahlstrom writes, “Electronic communication media (e.g., e-mail, text messaging, instant messaging, and social networking) and the proliferation of personal, handheld mobile devices are the obvious explanations for how technology connects students with others.” (Dahlstrom, 2012, p. 10) Many students say they are comfortable using social networking as a way to communicate and connect with other students, and even professors, about coursework; though, the majority of students (57%) said they prefer to maintain boundaries between their social lives and academic lives. (Dahlstrom, 2012, p. 25)

4. Personalization

Learning is most effective when the content is relevant to the learner’s world. But how can a teacher in a traditional classroom accomplish this with 30 or more students? Multiply that by five or more if you are talking about middle or high school classes—and even more in college lecture settings.

Mobile learning devices are the vehicles that enable each user to facilitate his or her personalized learning. The teacher provides the environment and context—and asks the question. The students can then personalize their responses by providing relevant examples through video, audio, text, collaboration, and many other possibilities that mobile devices enable anywhere and anytime. And because there are more audio, visual, tactile, and kinetic options afforded by mobile technologies, teachers also can personalize instruction for learners with different needs or learning styles.
Teaching with mobile devices

One of the critical elements to the success of mobile learning in education is the effectiveness of the teachers. Many are just learning to use mobile devices themselves and are skeptical about using them in the teaching and learning process.

On the other hand, those teachers, principals, and administrators who are already mobile users have a high regard for incorporating mobile devices in the classroom. “Moblist” teachers say the greatest benefits are increasing student engagement, providing access to digital textbooks, and extending learning beyond the end of the school day. Additionally, two-thirds of the mobilist teachers say that a mobile device would provide a way for instruction to be personalized for each student.

What is an ideal mobile teaching environment?

The ideal mobile teaching and learning environment involves the seamless integration of the devices into instruction. Mobile device use must be natural for both teacher and learner in order for it to cease being a distraction. It must augment, not supplant the teaching and learning process. (Project Tomorrow, 2012)

What are the skills teachers need to use mobile learning devices effectively?

Teachers need to be able to identify appropriate contexts to use mobile learning devices. In order to do that, they need to understand the value of the devices and where they can help students optimize their learning while continuing to learn core subjects. They also need to identify content that will support the learning goals.

At this early stage in the adoption of mobile learning, when there are no clear guidelines, early innovators are paving the way. They are pulling together open education resources, teacher creativity sites, and some commercial apps. Until we have professionally vetted, high quality resources that are tied to the Common Core Standards—with formative and summative assessments, and ongoing professional development, it’s not appropriate to require teachers to adopt these devices.

The interesting challenge at this early stage of integrating mobile learning devices is that baseline research on the effectiveness of using these devices is minimal. So the professional development must include best practices gleaned from schools and districts that are the early adopters.

In order to address the gap between the digital immigrants (teachers who are new users of mobile learning devices) and the mobilists or digital natives, the answer must come in the form of professional development on the effective use of mobile learning devices. It is not only for teachers but also administrators and college professors.

What is the ideal form of professional development to teach teachers to use mobile devices effectively?

The National Writing Project (NWP) offers a model that works for K-12, community colleges and four year colleges. Its national program model contains a set of shared principles and practices for teachers’ professional development. Its goal is to develop a leadership cadre of local teachers called “teacher consultants.” The NWP trains these teachers in summer institutes. Here are two of the core principles that pertain to mobile learning devices:

- Provide frequent and ongoing opportunities for teachers to use mobile learning devices and
- Examine theory, research, and practice together simultaneously.

There is no single right approach; however, some practices prove to be more effective than others. A reflective and informed community of practice is in the best position to design and develop comprehensive programs using mobile learning devices effectively.
These principles suggest going slowly and taking advantage of pilot projects. Try it first before implementing new practices district-wide.

**Best practice: Mooresville Graded School District**
http://www.mgsd.k12.nc.us/MGSD/Home.html

In 2009, the Mooresville Graded School District in North Carolina started a pilot project to integrate mobile learning devices in all of its classrooms. By 2011 they had scaled the project to many of the schools, replicating best practices from the pilot. One of the key factors was ongoing immersive professional development. The project’s results included increased student engagement as well as higher test scores in reading and math. District officials learned to start with passionate innovators in the pilots. They give up their scripted lectures, printed textbooks and the predictable curriculum flow and become ‘guides on the sides’! They document best practices and share with the general teachers as the initiative is scaled to more schools. “You have to trust kids more than you’ve ever trusted them,” superintendent Mark Edwards shared. “Teachers have to be willing to give up control and help students guide their own learning.” (Natsu 2011)

**Mobile Trends in K–12 and the Drivers Behind Them**

Mobile learning is a rapidly changing area of study with reports and studies appearing weekly. This section gives a sense of their scope.

<table>
<thead>
<tr>
<th>There is an increasing emphasis in K–12 on more challenge–based, active learning.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenge-based learning and similar methods foster more active learning experiences, both inside and outside the classroom. As technologies such as tablets and smartphones now have proven applications in schools, educators are leveraging these tools, which students already use, to connect the curriculum with real life issues. (Johnson, Adams, &amp; Haywood, The NMC Horizon Report: 2012 K-12 Edition, 2012, p. 8)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Common Core Standards are driving many curriculum changes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The advent of Common Core Standards across the states plus ubiquitous platforms and open source content allow districts greater flexibility to choose a wider variety of content resources to meet the local students needs as well as engage learners through multiple learning modalities. Content can be tailored to meet students’ needs while striving to meet the Common Core Standards. The digital content backed by sophisticated learning analytics measure student outcomes while informing instruction in new, non-invasive and exciting ways. (Parthenon 2012, p. 25)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Essential Use vs. Supplemental Use: when devices can impact student outcomes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norris &amp; Soloway report that “in reviewing the empirical literature on the use of computing devices in the classroom -- laptops on carts, desktops in a lab, even 1:1 laptop programs – we observed that when computers are used as a supplement to learning, as an add–on to learning, student achievement is not positively impacted. When computers are used as glorified typewriters for an hour a week or Google search engines in studying a science or social studies unit, no discernible increase in student achievement is recorded (Norris, Hossain, Soloway, 2012). In contrast, when computing devices are used as essential tools then increases in student achievement are observed. A necessary condition for “essential use” is 1:1 – each child having his or her own computing device. (But, as we noted above and further analyzed in (Norris, Hossain, Soloway, 2012), 1:1 is in no way a sufficient condition to ensure essential use.) Essential use is marked by the following:</td>
</tr>
<tr>
<td>• students use their devices for extended periods of time inside the classroom and outside the classroom;</td>
</tr>
<tr>
<td>• students use their devices for a diverse set of learning activities;</td>
</tr>
<tr>
<td>• students use their devices to support collaborative learning activities.” (Norris &amp; Soloway, 2013, p5)</td>
</tr>
</tbody>
</table>
The use of cloud services and collaboration in the cloud is on the rise.

The integration of collaboration tools in formal education settings ranging from social media to video conferencing to cloud-based productivity tools, such as Google Apps, is increasing along with the proliferation of mobile devices. Also having big data stored on the cloud that students, teachers and parents can access anywhere is changing the landscape in terms of how quickly data can improve teaching and learning.

The format in which students digest content is evolving.

As content has become digital and mobile, the format has changed from text-only to rich interactive media. Students don’t simply download files, but rather, interact with content through touch-based technologies and apps. They have direct and immediate access to information, events, locations, and data.

One growing form of digital content is gamification. This new e-learning environment allows for the integration of games and entertainment to create an immersive experience that can accelerate the learning process. Gamification provides interactive edutainment, increasing student engagement and alternative ways of extending the learning process. These edu-games can be accessed on mobile devices 24/7. (IBIS 2013, p. 39)

BYOD is gaining traction in school districts.

As the cost of technology drops and school districts revise and open up their access policies, it is becoming increasingly common for students to bring their own mobile devices. (Johnson, Adams, & Haywood, The NMC Horizon Report: 2012 K-12 Edition, 2012, p. 7)

A growing number of schools are launching “Bring Your Own Device” (BYOD) or “Bring Your Own Technology” (BYOT) programs so that students can use the devices they already own in class as well as in the informal and out-of-school environments they are ubiquitous in now. This is happening partly because of how BYOD impacts budgets; schools can spend less money on technology overall if students use their own, while funneling the funds they do spend to help students who cannot afford their own devices. The interest in BYOD programs can also be attributed to an attitude shift as schools are beginning to better understand the capabilities of smartphones and other devices that still remain banned on most campuses. (Johnson, Adams, & Haywood, The NMC Horizon Report: 2012 K-12 Edition, 2012, p. 5)

Mobile technologies are defining personal learning environments.

Learning is becoming increasingly personalized with e-Learning harnessing big data analytics to provide interactive learning that is tailored to meet the individual’s learning patterns and aptitudes. The conceptual basis for personal learning environments (PLEs), which are personal collections of tools and resources a person assembles to support their own learning, both formal and informal, has shifted significantly in the last year, as smartphones, tablets, and apps have begun to emerge as a compelling alternative to browser-based PLEs and e-portfolios. There has been a corresponding move away from centralized, server-based solutions to distributed and portable ones.

Despite the use of the word ‘environment’ in the name, the notion of a physical or virtual space is somewhat irrelevant to a PLE. The goal is for students to have more control over how they learn in school, just as they do at home, and for teachers to set expectations that their students will be actively engaged in designing and supporting their own learning strategies.


The learning analytics that underlie many of these digital content solutions also provide invaluable information as to the progress of each student as well as to the reference data collected from other students. (IBIS 2013, p. 39) These big data analytics enhance efficiency and create adaptive learning environments.
Mobile apps have caused schools to revisit their policies on the use of mobile devices.

Smartphones including the iPhone and Android have redefined what we mean by mobile computing, and in the past three to four years, the small, often simple, low cost software extensions to these devices—apps—have become a hotbed of development.

The power of apps, coupled with the portability of mobile devices, is causing many schools to take another look at their policies regarding mobile devices. Many see mobiles as a key aspect of Bring Your Own Device (BYOD) environments. (Johnson, Adams, & Haywood, The NMC Horizon Report: 2012 K-12 Edition, 2012, p.11). Acceptable Use Policies are being revised to protect students, student data, and to recommend acceptable behaviors when working online.

Development of media-rich, interactive content is driven by the popularity of tablet computing.

Mobile apps designed for tablets have given many traditional print-based publications a new life, and new tools, such as iBook Author and iTunes U, are making it very easy for anyone to create and publish media-rich interactive pieces. The newest version of iBook is optimized for viewing interactive textbooks, and e-readers for the Kindle and Android platforms are heading the same direction. (Johnson, Adams, & Haywood, The NMC Horizon Report: 2012 K-12 Edition, 2012, p. 11)

Apps that support learning are commonplace. The K-12 education sector is beginning to capitalize on this by integrating mobile apps into the curriculum and revising their school policies to allow the use of mobile devices and by extension, mobile apps. (Johnson, Adams, & Haywood, The NMC Horizon Report: 2012 K-12 Edition, 2012, p. 12) “Apps in particular are the fastest growing dimension of the mobile space in the K-12 sector right now, with impacts on virtually every aspect of informal life, and increasingly, potential in almost every academic discipline. Always-connected Internet devices using 3G, 4G, and similar cellular networks, imbedded sensors, cameras, and GPS have inspired hundreds of thousands of applications.” (Johnson, Adams, & Haywood, The NMC Horizon Report: 2012 K-12 Edition, 2012, p. 4)

Schools are modernizing their network infrastructure as a result of the growing demand driven by mobile technology.

The growth of mobile initiatives, digital learning and data streaming, as well as the demand for constant Internet connectivity, are driving educational institutions to modernize and upgrade their network infrastructures. Eighty-nine percent of districts are upgrading their networks to prepare for digital content growth and 76 percent are upgrading network capacity to support bring-your-own-device (BYOD) initiatives. (Center for Digital Education, 2012, pp. 6-7)

Desktop virtualization is growing in K-12.

A mobile technology and BYOD enabler, virtualization lets institutions administer desktop environments in the cloud and deliver personal environments to students, regardless of the device.

“According to the Center for Digital Education’s 2011-12 Digital School Districts Survey, approximately 25 percent of responding districts have implemented or are implementing desktop virtualization and 48 percent of responding districts are considering or planning to undertake a desktop virtualization initiative (Center for Digital Education, 2012, p. 12)
Nearly every K-12 student will be using a handheld, mobile device for education by 2015.

As teachers and administrators become more personally familiar with the benefits of mobile devices, online learning and digital media, some of these innovative leaders are also placing new expectations on their schools to better leverage these technologies for learning. (Project Tomorrow, 2012, p. 4) People expect to be able to work, learn, and study whenever and wherever they want. (Johnson, Adams, & Haywood, The NMC Horizon Report: 2012 K-12 Edition, 2012, p. 7) Norris and Soloway predict all students will be using a mobile learning device by 2015.

Students’ and educators’ expectations are driving rapid adoption.

The new millennial learner expects anytime, anywhere access to resources and information, a personalized environment, and the opportunity to collaborate. His/her technology must be always available, personal and learner-centric. Lifestyle and image drive smartphone sales to millennial learner as opposed to functionality. (Temesi, 2013)

Flipped classrooms are facilitated by mobile devices.

The flipped classroom inverts the traditional teaching model by delivering instruction online outside of classroom and moving homework into the classroom, thanks in part to mobile technologies. The teacher becomes the ‘guide on the side’ in the flipped classroom rather than the ‘sage on the stage’ in the traditional classroom.

Students watch lectures at home at their own pace, communicating with peers and teachers via online discussions. Then concept engagement takes place in the classroom with the help of the instructor. Mobile devices enable students to get online for their assignments or to watch video related to the study topic. This blended learning model is facilitated by the devices enabling students to carry their content from classroom to home and back for continuity of learning.

The cost benefits of mobile devices (compared to desktop computers) come from their lower power requirements and lower price.

“The electricity costs of a single computer may appear to be trivial, but the cumulative cost of electricity for all computers in a school can be substantial. Desktop computers consume substantially more electricity than do laptops.”

“The electricity to power one student laptop costs about $11 a year or $55 over five years. Netbooks cost less, since they take less power. If students charge their laptops at home, the savings are higher (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2010, p. 122) Mobile options, such as "carts on wheels" or COWs, which are usually stocked with laptops or tablets, appeal to budget conscious schools. "The cost of a fully equipped computer lab has been estimated at $400,000—equivalent to the purchase price of 13 COWs." (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2010, p. 49)

“It is important to be aware that computers in schools are aging at an alarming rate, and funding for replacements is dwindling just as fast.” (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2010, p. 47) Whatever schools have today, needs to be replaced within five years.
Eliminating computer labs saves space in schools.

“The use of space in schools has come under increasing scrutiny over the past few years, with an increased focus on designing schools to support improved learning and simultaneously cut costs. The transition to mobile computing can lead to fewer dedicated computer labs.” (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2010, p. 122)

Larger, high-resolution screens are now available on tablets.

“High-resolution screens allow users of tablets, such as the iPad and Galaxy, to easily share content, images, and video. They are engaging and viewed as less disruptive than other hand-held devices (no phone ringing and no incoming text messages). Because tablets are able to tap into all the advantages that mobile apps bring to smaller devices but in a larger format, schools are seeing them not just as affordable solutions for one-to-one learning, but also as feature-rich tools for all sorts of assignments as well, often replacing far more expensive and cumbersome devices and equipment.” (Johnson, Adams, & Haywood, The NMC Horizon Report: 2012 K-12 Edition, 2012, p. 4)

Three specific trends to study

Now let’s investigate some of the key trends that are impacting mobile learning in education: BYOD, collaboration, and cloud-based services.

Once school districts started talking about 1:1 computing, BYOD looked like a cost-effective way to get a sufficient number of new devices.

Bring Your Own Device (BYOD)

As the cost of technology drops and school districts revise and open up their access policies, it is becoming increasingly common for students to bring their own mobile devices. (Johnson, Adams, & Haywood, The NMC Horizon Report: 2012 K-12 Edition, 2012, p. 7) This movement has earned the name Bring Your Own Device (BYOD) or Bring Your Own Technology (BYOT).
In K-12 schools the prevailing wisdom as this movement started was that BYOD was the only way schools could move to 1:1 computing. Districts could not afford to buy enough devices for all students so if those who could afford them brought their own, schools could backfill devices for those who could not afford them.

Also, most districts are dealing with rapid obsolescence of their technologies. "It is important to be aware that computers in schools are aging at an alarming rate, and funding for replacements is dwindling just as fast." (Greaves, The Technology Factor, p. 47) The cost of replacing the obsolete computers with BYOD plus supplementing the mobile inventory for students who cannot afford them was and is much more attractive than replacing an entire set of computer labs and desktops.

Many naysayers bemoaned the fact that this movement would end a consistent technology environment where every device would be the same, every interface would be the same, and every teacher could expect "sameness" in the technologies and their capabilities. But they could not deny the heightened engagement of students using these devices and the increased interest in their application across the subject areas.

“The interest in BYOD programs can also be attributed to an attitude shift as schools are beginning to better understand the capabilities of smartphones and other devices that still remain banned from most campuses.” (Johnson, Adams, & Haywood, The NMC Horizon Report: 2012 K-12 Edition, 2012, p. 5). The power of apps, coupled with the portability of mobile devices, inherently has the potential to change both formal and informal learning.

Mobile devices with their built-in connectedness facilitate collaboration, mentoring, and writing for a real audience. But giving students these capabilities requires the development of policies addressing privacy, security and respect.

Collaboration

One of the most exciting benefits of mobile technologies for teaching and learning is the capability that mobile devices lend for collaboration. The interchanges can be mentoring and tutoring from teachers, study groups with peers, communicating with experts from local or remote locations, etc. Students can connect and collaborate on projects, topics, games, etc.

The other benefit of the collaboration is something we learned with the advent of word processing—the value of writing for a wider audience than just the teacher. Mobile devices enable the ability to present, broadcast, comment, etc.

That is the good news. The bad news is students do not necessarily understand the morality or the need to respect others’ privacy, respect themselves in what they broadcast, or understand the importance of security. These issues now must be part of the curriculum, the schools’ policies, and professional development for teachers and administrators.
Schools are turning to the cloud to store increasingly massive amounts of data (for example from student projects), to enable collaboration (for example among students separated by distance or time), and to provide access to a common set of productivity tools.

Education’s IT administrators hope the capabilities of the cloud will offer data management substitutes for their ageing, incompatible, and inadequate legacy systems. However, it’s still much too early to know the entire cost of the investment required or the real return on investment.

Cloud services
According to a recent CDW Government survey, 40% of schools are turning to cloud services, a trend that coincides with the explosive growth of mobile computing. Another 36% of schools are turning to the cloud for conferencing and collaboration. And access to productivity tools is the third big reason schools are turning to the cloud—about 30% of them. Let’s analyze why these are so important to mobile learning:

- **Storage**—Mobile devices enable students to capture video and sound that is timely and relevant to the subject they are studying. They can easily integrate it into projects to share with peers, teachers, and a wider audience. However, the more video and audio that are captured, the more storage needed. The storage needs to be easy-to-use and accessible on-demand via dashboards that help categorize, store, and retrieve the files anywhere and anytime.

- **Collaboration and conferencing**—The integration of collaboration tools in formal education settings—ranging from social media to video conferencing to cloud-based productivity tools, such as Google Apps—is increasing along with the proliferation of mobile devices. (Nagel, “Cloud Computing to Make Up 35% of K-12 IT Budgets in 4 Years”, 2013)

As noted above, the immediate access to peers to collaborate about a project, a topic, a game, a challenge—all enhanced by the anywhere, anytime use of mobile devices—is undeniably changing how we teach and learn. But all of this requires immediate remote access to massive amounts of data when you consider the size and numbers of students in education systems and institutions. Server space and legacy systems have hampered activities such as these in the past, but the move to the cloud has stimulated breaking down these artificial barriers. 24/7 access is turning students into constant learners. Using the cloud, study groups can form in an instant and share the assets they have stored about a topic.

- **Access to productivity tools**—In the past, we were bound by the limitations of the tools resident on our computers as we tried to share files. Often the tools in one school were different in another, so sharing across schools, districts, institutions, or even with peers in other places was cumbersome, limited, and frustrating.

Now a common set of tools on the cloud can be accessed by many. Students and teachers can comment on the work of others. Some tools even allow real-time interactions where you can see and comment on the changes others are making—rather than waiting to see feedback long after the topic has lost its interest.

- **Cost reduction**—The IT departments revel in the advent of the cloud in education. Costs have run amuck with legacy applications on obsolete server systems that track massive amounts of student data, do not integrate with each other, and demand human resources with unique skills to manage their specific quirks. Now with BYOD, a myriad of mobile devices try to access data from them with their various protocols.

The return on investment of the cloud has been touted to be much higher, which IT administrators find very intriguing. Over time we will know just how great the return on investment is, but we know it is much more attractive than multiple legacy systems that cannot handle the onslaught posed by the growth of mobile learning and the sheer number of multiple devices that can be accommodated.

The cloud holds promise, and maybe offers unreal expectations. But at least it offers a potential solution to handle the exploding amount and types of data that schools must now manage and make accessible 24/7.
Challenges for Mobile Learning Content in K–12

Content

In terms of mobility, cloud-based and SaaS products can be used by students, parents and teachers, at home and at school. They allow collaboration, data sharing, lesson planning, and project-based learning across classrooms, schools, districts and even nations. (BMO Capital Markets 2013, p. 19) But this raises the question of delivery and compatibility. Will all the content be available for all the versions of all the devices?

There is also a bigger question educators must address: Who’s producing, reviewing, and selecting the content? As recently as 10 years ago, K–12 schools followed prescribed learning paths presented to them through multi-year curricula via textbooks produced by publishers who participated in controlled adoption processes in each state. Today, given the advent of digital content and the fiscal pressure to reduce costs, states and districts are looking to change the paradigm that has ruled curriculum decisions for decades. Textbooks adoptions are not being renewed. Districts are getting the flexibility to purchase digital content to teach concepts previously taught through textbooks.

But who is evaluating these new offerings? When you think of the incredible growth of the number of digital content solutions, evaluation is a daunting task. Where is the rigorous research to show that the content resources available for mobile devices are pedagogically sound? Who is checking the claims of their creators, many in very small companies that did not exist last year, or created by individuals with little or no training on curriculum development?

For districts making the shift to digital content, these are important questions to consider. The development of the Common Core Standards is the beginning of a structure. But districts must establish their own scope and sequence and determine what digital assets they will use to help students meet these goals.

The good news is that digital content allows schools to create unique, customizable educational solutions that meet specific needs of their students and teachers while matching required standards such as the new Common Core State Standards.

Best Practice: Rocketship Education

http://www.rsed.org

In a recent interview with Preston Smith, CEO and Co-Founder and President of Rocketship Education, a charter school business currently located in California, the challenges of using mobile learning devices to support transformational learning were discussed. Many of their teachers were new lacking experience using online programs in the classroom, personalizing learning for students, and choosing appropriate content to use with the students. Also managing the complexity of multiple devices was difficult from the IT perspective. And since parental involvement is a critical component of the Rocketship program, ensuring connectivity in homes to reduce the digital gap was daunting.

To address these challenges, the team made some important decisions that others might consider:

• They narrowed the number of digital resources by choosing only those that were carefully vetted, aligned with their instructional goals and were easy to use.
• They provided ongoing professional development including facilitating communities of practice among the teachers to share best practices
• They developed the technical skills of their assistant principals so they could provide technical support at each site to help teachers and principals manage the use of digital content and devices in their programs.
Implementation, support, and infrastructure
This is especially difficult for large wireless or mobile upgrades with the aim of supporting hundreds or thousands of devices. While unique technology solutions may resolve some of these issues, tech support demands generally increase.

Professional development
New technology requires more training for teachers and administrators to ensure better return on investment. Districts need to consider newer online training options that provide just-in-time access for educators as well as online workshops.

Integration and interoperability
BMO Capital Markets believe that “integration across networks and devices poses considerable integration hurdles and that users are wary of products that lock them into full solutions. Educators should consider non platform-specific tools and content to address these challenges.” (BMO Capital Markets 2013, p. 13)

Assessment
The benefit of digital content is that students can access it 24/7. Learning analytics can provide just-in-time windows on the performance for all students. But the challenge is what to do with all the data. How does a teacher stay on top of it to effectively inform instruction? Educators should consider choosing tools to help sort through the data and understand which drivers are most important to impact each student’s learning in a timely and easy to use process.

Access
This is one of the biggest challenges many districts will face as mobility continues to grow. It is at several levels: access to online content 24/7, access to mobile devices and access for all families. Each district must consider how they will approach this challenge and ensure equity of access to all students.

Security
Never before have so many parties collaborated in virtual communities. Never before has there been more access to data about student performance. Never before have so many different parties had access to data about student performance. But this raises a huge red flag that districts must address – student privacy. There must be many levels of access and accompanying security with each, to ensure students are safe as they learn, share, collaborate, and are assessed. The learning analytics that track their progress must be managed carefully.

Policy and Regulations
With this rampant growth of the use of digital content and cloud-based solutions, there must be thoughtful, non-invasive regulation that shapes and protects the users at all levels. The federal government provides definitive guidance on student privacy but state and local policies must be in place for use, security, safety, and access that address all levels of users.

Digital Literacy
Ironically, even though the millennial students in our K-12 schools are digital natives, this does not mean they all know how to use technology for learning. Gloria Keaton of Annapolis Road Academy stated at EdNET 2012 that “Facebook and texting does not count as digital learning skills”. Teens see mobile devices as tools for entertainment and communications. Having multiple devices does not equate with knowing how to effectively use them in the learning process. Schools must determine what the skills are that students need to support pedagogy.
Trends in Higher Education and the Drivers Behind Them

The postsecondary market has been split into two divisions – academic and administrative. In terms of mobile learning, the most growth to this point has been in the academic realm.

The growth of mobile learning by students in higher education has been a grass roots movement rather than a top down decision. In large part, this is because students arrive at college with multiple mobile devices of their own.

Compared to what’s happening in K-12, the growth of mobile learning in higher education has been a grass roots movement rather than a top down decision. Students arrive at college with multiple mobile devices that they already own. In fact the New Media Consortium’s Horizon Project in 2011 studied the Six Emerging Technologies impacting Higher Education. Number one was mobilization (mobile computing and devices of smart phones, tablets and mobile apps).

Institutions have the opportunity to deliver education and student services “On Demand and In Students’ Hands” (a motto coined by the Tennessee Board of Regents). Institutions are beginning to embrace the ability to augment traditional education with online learning environments.

Due to the high percentage of college students that have mobile devices, the educational opportunities of mobilization are still being discovered. Expected areas of transformation include recruiting, teaching, learning, delivery, communication, social interactions, and campus operations.

To manage this digital growth, institutions across the country have adopted various forms of Learning Management Systems (LMS) with web–based platforms and front–end tools (i.e. collaborative) to augment instruction, course design services, digital course materials, content and research engines, etc.

A growing number of institutions of higher education are augmenting or modernizing their network infrastructure.

Twenty–one percent of community colleges have plans to implement unified communications, voice, data or video in the 2012–2013 timeframe. Approximately 40 percent of community colleges note infrastructure initiatives–wireless, networking, bandwidth and connectivity–as a top priority moving forward. (Center for Digital Education, 2012, pp. 6-7)

In a 2012 survey of community colleges in 26 states, wireless infrastructure was cited as the second highest priority on the list of ten IT priorities (mobile computing topped the list). (Center for Digital Education, 2012)

Eighty–seven percent of higher education IT professionals indicated that they need to upgrade their infrastructure in order to incorporate more technology in the classroom, with “42 percent of higher education officials indicating wireless and networking infrastructure as a key component of that upgrade.” (Center for Digital Education, 2012, pp. 6-7)
The use of online video and lecture capture technologies is rising. There is greater acceptance among professors to embrace the use of digital content, online learning, collaboration and the value of lecture capture. The greater analytical capability of the new digital tools actually provides them the ability to personalize instruction as never before. They no longer are threatened by online learning as a replacement; rather they see it as an enhancement and an extension of their value.

Professors are very big users of video in their teaching. Virtually all (88 percent) of faculty report using video in their class sessions. (Moran, Seaman, Ph.D., & Tinti-Kane, 2012, p. 20) As these instructors are increasingly using online video as a teaching aid, there is a need for more bandwidth as well as demand for network connectivity. (Center for Digital Education, 2012, pp. 6-7)

Respondents representing community colleges in 26 states in CDE’s 2012 Digital Community Colleges Survey reported that the expanded use of “lecture capture” was on their list of top ten IT priorities. It is not surprising given this move that more than 50% of higher education students use recorded class lectures, and students list recorded class lectures as the top technology they’d like to see more of in the classroom. (CDW-G)

There is an increase in the use of cloud storage and online, browser-based applications that are device independent. “The technologies we use are increasingly cloud-based, and notions of IT support are decentralized.” (Johnson, Adams, & Cummins, The NMC Horizon Report: 2012 Higher Education Edition, 2012, p. 4) The advent of MOOCs (Massive Open Online Courses) that enable anyone, anywhere to take a course online, often for little or no cost, challenge traditional models of instruction, IT support and learning using crowd-sourcing social technologies. Thousands of students can participate in a course that must constantly enable user input. Courses are device and time independent.

Given this type of massive growth of cloud-based instruction, it is not surprising that the ongoing migration to cloud computing technology was cited as the seventh IT priority from a list of ten in The Center for Digital Education’s 2012 Digital Community Colleges Survey. (Center for Digital Education, 2012)

Students’ and educators’ expectations are driving rapid adoption. “...People want easy and timely access not only to the information on the network, but also to tools, resources, and up-to-the moment analysis and commentary. These needs, as well as the increasingly essential access to social media and networks, have risen to the level of expectations. (Johnson, Adams, & Cummins, The NMC Horizon Report: 2012 Higher Education Edition, 2012, p. 4)

The availability of high-quality digital content continues to grow. “The move to mobile computing on campus coincides with a push among educational publishers toward digital content, such as electronic textbooks, multimedia-rich applications, online videos, and other online tools for teachers and students.” (Wong, 2012, p. 56)

Every institution is looking at how they’re handling the variety of tools on campus, the enablers that allow the instructor to deliver instruction. Campuses are at different stages with regard to how they use video, ranging from immersive telepresence to desktop to mobile devices. Now, mobile offers a high-definition, high-quality video experience on a tablet. (Stillman, 2013)

Browser-based solutions continue to proliferate. “Globally, in huge numbers, we are growing accustomed to a model of browser-based software that is device independent. While some challenges still remain, specifically with notions of privacy and sovereignty, the promise of significant cost savings is an important driver in the search for solutions.” (Johnson, Adams, & Cummins, The NMC Horizon Report: 2012 Higher Education Edition, 2012, p. 4)
Technologies are increasingly cloud-based. The transition to cloud computing will drive policy discussions about cost, data security, and functionality.

As with K-12, technologies are increasingly cloud-based and IT support for these are decentralized. The continued transition to mobile computing will coincide with the shift in the role of servers from data centers to a cloud environment in both the public and private sectors. Cloud computing will drive many policy discussions around cost, data security, functionality, and other important topics. (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2010, p. 48)

The interesting cloud trend comes from a Gartner Group study: the personal cloud will replace the personal computer as the center of a user’s digital life by 2014. That definitely bodes well for the shift to mobile learning! (Forbes.com)

While colleges struggle with the costs for a digital transition, IT professionals say they need to upgrade the infrastructure.

Finally, just as in K-12, colleges struggle with costs for this transition to digital teaching and learning and the accommodations that must be made to effectively integrate mobilization. Yet spending is predicted to remain relatively flat at $10.3B in 2013 due to the recovery from the recession. (Center for Digital Education)

Campuses are at different stages of adoption of the mobilization movement. However to accommodate for these changes 87% of higher education IT professionals indicated they need to upgrade their infrastructure in order to incorporate more technology in the classroom, with “42 percent of higher education officials indicating wireless and networking infrastructure as a key component of that upgrade.” (Center for Digital Education, 2012, pp. 6-7)

But just as in K-12, it’s important to remember that “mobile learning” is about what’s going on in the students’ heads—not the devices that are in their hands. Decision makers must ask one another, “What do you want to achieve? How will you get there? How will you measure success?”

Teaching and learning is the ultimate goal.

According to Tom Haymes of Houston Community College, “The ideal ‘mobile’ environment involves the seamless integration of the devices into instruction. That integration must be naturalistic for both the faculty member and student for technology to cease being a distraction to teaching and learning... Technologies should always be designed first and foremost to augment the process of teaching and learning.” (Haymes, 2012)

Some higher ed campuses facilitate collaboration with sophisticated conferencing solutions.

On some higher education campuses, new, sophisticated video- and web-conferencing tools allow faculty and students to work more closely together. Mobile-device accessible cloud-based solutions enable anytime, anywhere meetings—small study group to large lecture hall—with live video and audio support. Familiar social networking functionality and other collaboration features may be included too, such as messaging, text chat, file sharing, desktop and screen sharing, a virtual whiteboard, and session recording, to name a few. Faculty members can use conferencing tools to hold online office hours; students can reserve virtual “rooms” to collaborate on projects. Feature-rich web-conferencing tools provide users “front row” participation no matter where they are.
An annual survey of nearly 4,000 higher education faculty revealed that almost 34% of faculty members use social media for instruction. The type of social media site most frequently used for teaching was blogs and wikis, followed by podcasts. Younger faculty members (41% of the respondents under the age of 35) show the highest rate of social media integration, while their peers over the age of 55 used social media in their teaching the least often (30%). Use varied by discipline. (Moran, Seaman, Ph.D., & Tinti-Kane, 2012, pp. 14-15)

Other professors have not transitioned to mobile apps. Some professors still teach using a specific application and in a specific environment; but, because things are constantly evolving, there is a need to look at the task to be accomplished, and then the user determines what tools to use to get it done. Those tools may no longer be a specific software application. (Schlegelmilch, 2013)
Higher ed faculty are also concerned with cheating and privacy issues. Among the chief barriers to using social media, according to higher education faculty, are the integrity of student submissions and privacy concerns, followed by concern about needing to maintain separate course and personal accounts. (Moran, Seaman, Ph.D., & Tinti-Kane, 2012, pp. 24-26)
Forecast for K–12 and Higher Education

K–12 IT managers expect 1:1 student to device ratio in 5–10 years.

In a survey of K–12 IT managers, 100% said they expected their school to have a one-to-one student to device ratio in 5–10 years. Most of those managers felt that BYOD policies will be the primary driver in reaching the one-to-one ratio. (CDE 2012 Yearbook, p. 12)

Visual communications takes video conferencing to a new level.

Programs like WebEx, SKYPE, FaceTime, and others provide video communication on phones, tablets, and home televisions. Visual communications will be integrated with current video conferencing systems, fueling this as a main relationship-building tool for businesses of all sizes. (Burrs)

E-books, e-newspapers, e-magazines and interactive multimedia e-textbooks pass the tipping point.

This threshold is crossed due to the "abundance of smart phones and tablets that provide a full color experience, and publishers providing apps that give a better-than-paper experience by including cut, copy, paste, print, and multimedia capabilities."

Apple’s iBook Author and other tools will drive interactive e-textbook creation, “freeing new publishers to create compelling and engaging content, and freeing students from a static, expensive, and literally heavy experience.” (Burrus)

Cloud-computing and cloud-based services will continue to rise.

The continued transition to mobile computing will coincide with the shift in the role of servers from data centers to a cloud environment in both the public and private sectors. Cloud computing will drive many district policy discussions around cost, data security, functionality, and other important topics. (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2010, p. 48)

According to a Gartner Group study, the personal cloud will replace the personal computer as the center of a user’s digital life by 2014. (Forbes.com)

The total IT expenditure for public education is forecast to reach $20 billion in 2013.

The estimate for K–12 spending will be $8.8 billion with a 3.6% growth rate and for higher education $11.7B with a CAGR of 2.7% reaching $13.6B in 2016. (BMO Capital Markets 2013, pp. 5, 7, 22)
Mobile Device Statistics and Predictions

Data in this section primarily reflect mobile use in the United States. Countries with top-down, country-controlled education systems face issues that are far different from those in the United States where individual states control education and local control often has a large impact on educational decision making.

In a 2012 cross-sector research report called Worldwide New Media Market Model 1H–2012 Highlights: Internet Becomes Ever More Mobile, Ever Less PC-Based, International Data Corporation (IDC) makes the following predictions about the future of mobile technology:

- By 2015 more end users will access the Internet through a mobile device than a PC. By 2016, tablets will outsell both desktops and laptops.

In a recent survey by Grunwald et al, the percentage of students with mobile devices already making their way to school is 25% across K-12. By high school, half of all students (51%) carry a smartphone to school with them every day. In grades 3–5, about 8% and in middle school – 28%. (Grunwald 2013, p8)

K-12 teachers, librarians and administrators are increasingly depending on them for personal productivity.

The 2011 Project Tomorrow Speak Up results revealed that more than twice as many administrators (55%) had personal access to a tablet than teachers (26%). However, over half of all librarians, teachers, and principals had access to a smartphone, and 70% of administrators had access. (Project Tomorrow, 2012, p. 4)

Selection of mobile devices for K-12 education depends on factors such as the age of students, curriculum, and cost.

Elliot Soloway, co-founder of GoKnow, predicts that by 2016, nearly every K-12 student in the U.S. will be using a mobile handheld device as an important part of his or her education. In K-20 education today, the selection of a mobile device is guided by factors such as “the age and maturity of the students, the curriculum they are working on, and the unique needs they have in their academic and personal lives.” (Center for Digital Education, 2011, p. 6)

Students’ increased use of technology outside of school to personalize their informal learning opportunities is creating a new impetus for more tech enabled personalized learning inside of school. (Project Tomorrow, 2012, p. 4)

For younger students, such as those in elementary and middle school, smaller mobile devices such as tablets and netbooks are common. These devices may supplement classroom PCs or computers on carts (COWs). Tablets and netbooks also have the advantage of being relatively low-cost and lighter in weight than a laptop, making them a suitable choice for younger students.

Increasingly, high school students access the Internet through their mobile devices.

High schools have favored laptops for student use. By 2011, half of all high school students carried a smartphone. Now, seven out of ten high school students that have a tablet also have a smartphone and 55% of high school students say that their home Internet connection is now through a mobile device. (Project Tomorrow, 2012, p. 4-5) As mobile devices add more functionality, students are choosing to mix and match devices that they select “to support a particular educational goal,” (Project Tomorrow, 2012, p. 4) and when they are allowed to, bring their personal devices to use in class.
In higher education, device management, and integration into the curriculum, was cited as the first priority on a list of top IT priorities for 2013. In a 2012 Center for Digital Education survey of community colleges across 26 states, mobile computing—managing devices, and integration into the curriculum, was cited as the first priority on a list of ten IT priorities for 2013. In the same survey, 57% of the colleges cited mobile computing as a priority, and 19% of the respondents indicated that they are “learning more about it and/or preparing a business case for implementation.”

(Center for Digital Education, 2012)

Community colleges report using desktop virtualization. Approximately 60 percent of community colleges in one survey reported having desktop virtualization in place, a technology that advances the use of mobile and student-owned devices by letting an institution administer desktop environments in the cloud and delivering personal desktop environments to students on any device.

Tablet popularity on college campuses follows the BYOD movement. Tablet devices have “captured the imagination of educators around the world.” The rising popularity of tablets in higher education is partly the product of campuses across the world embracing the BYOD (bring your own device) movement. It is so easy for students to carry tablets from class to class, using them to seamlessly access their textbooks and other course materials as needed, that schools and universities are rethinking the need for computer labs, or even personal laptops.”

(Johnson, Adams Becker, Cummins, Estrada, & Freeman, 2013, p. 16)

Planning Your Mobile Program

“The Education Department’s 2010 National Educational Technology Plan (NETP) presents a transformational vision for 21st century education, depicting how new technologies can help people learn lifelong and “life-wide” – in libraries and museums and their homes, and through interactions with people in their neighborhood and community.

In particular, mobile devices enable learning anywhere and anytime, moving education beyond the industrial era model, where classrooms are the primary place of learning, the school day is the primary educational time, and the teacher is the primary source of information.” (Dede, 2012)

This report has reviewed the key elements that must be considered when setting up your mobile technology program: trends, features, barriers and predictions. But the exciting thing for you is that you now have the opportunity to benefit from what has been learned thus far as you are about to either begin a mobile program or are developing a plan to expand your existing program. Here are some key points to remember and some examples of best practices that you can consult as well as others we have pointed out in the report.
**Plan:** Create a strategic, multi-year plan. The most important thing to remember is you must have a vision that guides the development of your plan. This should be updated each year to help you evaluate your progress. Consider scalable, replicable pilot projects and develop case studies to share with other schools and districts. Also sustainable funding should be addressed in the plan. Here is a district that did just this:

**Best Practice: Katy Independent School District, Texas**

http://www.katyisd.org
http://katyisd.org/technology/Pages/default.aspx

This district started with a well-developed plan, which led to a pilot with 5th grade classrooms – using handheld windows devices. They chose the most enthusiastic teachers to participate in the pilot. The next year they expanded to multiple classrooms across the district.

Katy did an excellent job of public relations letting their community know of their successes. This made it easier to get support for the ongoing expansion of the program.

They also had a Web 2.0 initiative to improve teaching and learning. Students were engaged which led to higher test scores.

Katy was also a recipient of an FCC Broadband grant, which helped fund the infrastructure for the mobile program.

**Leadership:** Don’t forget to train your administrators. “Technology-rich schools whose principals ‘have formal training in change management far outperform the technology schools where [principals] don’t have this formal training,’ he says. ‘At a lot of schools, they just provide the technology and think that, by itself, will carry the day. But if you don’t actually give [educators] the training of what to do with it, nothing changes.” (Greaves, 2011.)

**Professional Development:** The success of the program is extremely dependent on the effectiveness of teachers. The training should not be an event; rather it should be systemic and ongoing. Be creative with how you carry out your PD: apps parties, videoconferences with other successful programs, online mentoring, etc. Also, nurture your early adopters. They will be your evangelists for other teachers entering the program.

**Best Practice: Abilene Christian University**

http://www.acu.edu/technology/mobilelearning/research/ipad-studies.htm

All students have iPads or iPhones. New research studies show students used iPads more frequently and with better results when compared to paper-only text.

The University conducts mini-visit weekends to share ideas on how to implement mobile programs effectively.
Parents: Partner with parents to make the case for mobile learning. Develop mobile device policies to help them guide their children’s use. Provide guidance on how to use mobile learning devices and apps for formal and informal learning, not just entertainment. Showcase best practices with mobile learning devices for parents not yet persuaded about their use.

Best Practice: St. Mary’s City Schools
http://www.smriders.net/Mobile_Learning/

This small rural district provides multiple resources to access all aspects of implementing a mobile program. They did an excellent job of reducing the need for IT. They increased student engagement. Test scores went up, not because of devices but more how teaching is done with the devices in a facilitative manner. They communicate constantly with parents to inform and garner support.

Access: Utilize the devices that students already have access to or are bringing to school (the BYOD approach). Rather than trying to be the sole provider of devices for all students, consider taking a need-based approach and provide devices only for students who do not have them – and ensure that students’ access is as equal as possible.

Visit Other Districts: One of the best recommendations for educational institutions is to talk to, visit other districts that have already launched their programs and are willing to share best practices. Here is one who has been visited by so many that they have put their information on a wiki to help them manage their time and to help other districts benefit from what they have learned:

Best Practice: Canby School District
http://www.canby.k12.or.us/

Canby has done an excellent job of documenting their program for other districts to access. They document their best practices while maintaining a Wiki for other districts to peruse and continue to update it as they expand their mobile programs.

Product: Partner with industry to contribute to the development of mobile devices, apps and content that deliver robust educational benefits.

There are also many other resources available to you. Some of these include:

- CoSN (the Consortium of School Networking) - Leadership for Mobile Learning initiative
  http://www.cosn.org/Default.aspx?TabId=8108
- ISTE (the International Society for Technology in Education) - Mobile Learning SIG
  http://www.iste.org/connect/special-interest-groups/sigml
- Mobile Technology Learning Center, University of San Diego
  http://www.sandiego.edu/soles.centers-and-research/mobile-technology-learning-center/
- MIT Center for Mobile Learning
  http://mitmobilelearning.org
- UNESCO Working Paper Series on Mobile Learning
Finally, the infographic on the following page was developed for CoSN’s Leadership for Mobile Learning initiative. It has been included for you as a guide as it reviews the seven implementation steps that are worth your consideration as you plan your mobile learning program.
Bibliography


Lugo, M. T., & Schurmann, S. (2012). Turning on Mobile Learning in Latin America. UNESCO.


Parthenon Perspectives, Understanding the Evolving K-12 Landscape, February 2012.


Parthenon Perspectives, Understanding the Evolving K-12 Landscape, February 2012.

Quazzo, Deborah H.; Cohn, Michael; Horne, Jason; Moe, Michael; Fall of the Wall, Global Silicon Valley Advisors, July 2012.


So, H.-J. (2012). Turning on Mobile Learning in Asia. UNESCO.


Zwang, Jenna. Ten of the Best Apps for Education. eSchool News. (2011, January 7)