What Can You Learn From A Cell Phone? – Almost Anything!

How to use the 1.5 billion computers already in our students' and trainees' pockets to increase learning, at home and around the world

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"When you lose your mobile, you lose part of your brain."
– a Japanese student

One-and-one half billion people, all over the world, are walking around with powerful computers in their pockets and purses. The fact is they often don't realize it, because they call it something else. But today's high-end cell phones have the computing power of a mid-1990's PC (while consuming only one one-hundredth of the energy, by the way). Even the simplest, voice-only phones have more complex and powerful chips than the 1969 on-board computer that landed a spaceship on the moon!

In the U.S. it's pretty much universally acknowledged that computers are essential for 21st century students, although there is still considerable debate about how and when to use them. But to most educators "computer" means PC, laptop or, in some instances, PDA. It's time we begin thinking of our cell phones as computers – even more powerful in some ways than their bigger cousins. Remember, even the simplest, voice-only cell phones have microchips and perform logical functions just as bigger computers do. The main difference is that the phones began with, and still have, *small size, radio transmission and communication* as their core features, expanding out toward calculation and other functions. This has happened at precisely the same time as the calculation machines we call "computers" have expanded into communication and other areas.

Clearly the two are headed towards meeting in the middle, and we will wind up, when all the miniaturization problems have been solved, with tiny, fully featured devices that we

carry around (or perhaps have implanted in our bodies.) But for now, most see these as very different animals, with the tiny cell phone being, among other things, a much more ubiquitous and personal device, especially among young people.

In America we don't fully appreciate the potential of these devices, since, from a cell phone perspective, we are a PC-centric laggard. The cell phone – generally called a mobile phone outside of the U.S. – has proved so useful elsewhere that there are 1.5 billion around the world, with half a billion new ones sold every year. The country where the computer was invented, along with its northern neighbor, Canada, are the only places in the world where PC's outnumber cell phones. In the rest of the world it's the mobile that reigns, with countries often having 5 to 10 times the number of mobile phones than PC's. In some countries and groups – such as students in parts of Japan, Korea, Europe and the Philippines – cell phone penetration is *over* 100 percent, which means that individuals own and use two or more of these devices. And of course usage is growing like a weed around the world, where relatively inexpensive cell systems are bringing phones to places without land lines.

The Computers in Their Pockets

Today's young people – I call them our "Digital Native" generation – have, in an incredibly short time, adopted these tiny computers in their pockets, purses and backpacks as their primary means of communication. They are using their cell phones for communicating by voice, text, and, increasingly, digital photographs and videos. And, increasingly, they are using them for computing, such as the digital signal processing which allows them to play ringtones and mp3s.

Students around the world increasingly carry these miniature "computing/ communication devices" during the school day, using them almost exclusively for personal purposes. Over 90 percent of Tokyo high schoolers have them, as do one in eight Botswanians.

Even in the PC-centric U.S., the penetration of student mobile phones is impressive. In high schools it is often over 75 percent, and in some schools it is almost 100 percent, as it is in most U.S. colleges. In U.S. elementary and junior high schools the number is over one-third, and fast approaching half the students. With dropping prices and increasing utility, it is almost a foregone conclusion that not too far into the future *all* students will have a cell phone, quite possibly built right into their clothing. Ski parkas with built in cell phones are already on the market.

Brain Extenders

"When you lose your mobile," says one student in Japan, "you lose part of your brain." The statement indicates an intuitive understanding of the link between Digital Natives and technology that has escaped educators. Most American teachers and administrators believe that cell phones have no place in the educational process. This is not totally surprising, since schools have never had an easy time integrating technology into

teaching. Far too often, and certainly today with cell phones, educators' knee-jerk reaction is to view new technologies as a "huge distraction" from the education they are trying to provide. Some imagine dozens of these phones ringing constantly, despite the fact that the devices have off switches and penalties can be collectively established and enforced by good teachers. Others observe "cheating" during tests via mobile phones and think that banning the devices – rather than educating the students – is the appropriate answer.

I feel sorry for these short-sighted educators, but even sorrier for their students. For as U.S. educators are busy banning cell phones in schools, millions of students in China and Japan, the Philippines, and Germany are using their mobile phones (respectively), to learn English; to study math, health and spelling; and to access live and archived university lectures.

Here's my point: Cell phones are not just communications devices sparking new modalities of interacting between people, they are also particularly useful computers that fit in your pocket, are always with you, and are always on. Like all communication and computing devices, cell phones, can be used to learn. So rather than fight the trend for kids to come to school carrying their own powerful learning devices – which they have already paid for! – why not use the opportunity to our advantage?

How Do We Do That?

But how? Can cell phones really provide their owners with the knowledge, skills, behaviors and attitudes that will help them succeed in their schools, their jobs and their lives? I maintain the only correct answer to the "What can they learn" question is "ANYTHING, if we design it right." There are many different kinds of learning and many processes that we use to learn, but among the most frequent, time-tested, and effective of these are listening, observing, imitating, questioning, reflecting, trying, estimating, predicting, "what-if"-ing and practicing. *All* of these learning processes can be done through our cell phones. In addition, the phones compliment the short-burst, casual, multi-tasking style of today's "Digital Native" learners. Using cell phones as a learning device, whether in or out of school, requires a good deal of rethinking and flexibility on the part of educators. But given the opportunity, we can be certain that students, as they have been doing with all useful digital technology, will quickly embrace and use the tool and make it their own in various unexpected ways.

Feature Segmentation

So what and how can our students – including adult trainees – learn from their cell phones?

A useful way to answer this question is to consider the capabilities phones in use today possess, and to see what each capability brings us. With half a billion cell phones sold each year, the devices are hotbeds of feature innovation—the major ones being voice, SMS, graphics, user-controlled operating systems, downloadables, browser, camera (still

and video), and geo-positioning—with new features, such as fingerprint readers and voice recognition, being added every day. In addition, there are optional hardware and software accessories, as both input mechanisms (thumb keyboards and styli) and optional output systems (such as plug-in screens and headphones).

Voice Only

But let's begin with the most basic of phones – those with voice capabilities only. These are still the most prevalent in the world, although they are fast being replaced and upgraded. They are basically radios, which pick up and send signals on certain pre-determined frequencies.

Is there anything students can learn on a voice-only phone? You bet! Let me suggest just a few of them: Languages. Poetry. Literature. Public Speaking. Writing. Storytelling. History.

Of these, language is probably the most obvious. Given the huge demand and market around the world for English lessons and practice, it's the one kind of learning that's already readily available on cell phones. In the UK, a company called CTAD has created voice-only mobile phone learning for school dropouts with language needs. In Japan you can dial a number on your cell for short English lessons. In China, the BBC and others are providing cell phone English language training. One company is even subtitling pop songs with their lyrics, highlighting each word as it is sung. Language games, such as crosswords and Tetris-like word puzzles, are being added as well.

Other types of voice-only learning applications also exist, and are growing in popularity. In Concord, Massachusetts, you can use your cell phone for an historically accurate guided tour of Minuteman State Park, where "the shot heard round the world" was fired. A UK university has experimented successfully with using cell phones for exams, with the students' voice prints authenticating that they are the ones being tested.

And it doesn't have to stop there. Have you ever listened to "Car Talk?" Or "Fresh Air?" Or the BBC? Remember, cell phones are basically radios. You don't need anything more than a voice link and a person on the other end worth listening to in order to learn a whole lot. Why not offer cell-phone delivered lectures (really engaging ones) on basic subjects, with cell phones call-ins and multi-way discussions?

An immediate advantage of voice-only learning is that we know it works – for millennia it was the only type of learning humans had. While some "Digital Immigrant" adults may have a difficult time with, and even question the value of, non-face-to-face voice communication and relationships for learning, virtual relationships are now second nature to students, and often preferred.

Additional inspiration in the voice (and sound)-only area we comes from research done for the blind and sight-impaired. As Jenkins, Squire and others have pointed out, many extremely useful voice-only cell phone approaches developed for this group, such as

voice-activated search engines and menus, can also be of great benefit to the sighted as well.

Short Text Messages (SMS)

Short Messaging Service (SMS), only recently introduced in the U.S., has been available on cell phones outside the U.S. for several years. This feature has caught on like wildfire among young people in Europe and Asia, with literally billions of SMS messages being sent every day around the world. SMS messages, which can be written quickly, even in your pocket (especially with "predictive text"), offer enormous learning opportunities.

Currently, SMS messages provide timely "learning" reminders and encouragement for people trying to change their behavior, such as quitting smoking. SMS is the technology used for voting on the TV show "America's Idol." It is used by marketers for informational quizzes about subjects of interest to young people, such as movie and TV stars. And innovative SMS games, many of which have strong educational potential, are attracting large playing audiences.

In schools, SMS can be used for pop quizzes, to poll students' opinions, to make learners aware of current events for class discussion (e.g. with messages from CNN Breaking News,) and even for tutoring and spelling and math tests. Outside of school, test preparation companies such as Princeton Review are already offering cell-phone delivered SAT and other test preparation questions at specific user-preferred times. It would be a simple matter to use SMS technology to provide cell phone learners, individually and in competitive/collaborative groups, with data and clues in real time for analysis diagnosis and response, whether in an historical, literary, political, scientific, medical or machine-maintenance context.

Graphic Displays

Just about every cell phone has some kind of graphic display, even if it shows only the signal and battery strength and the number or name of the person being called. But most new cell phones come with far more graphic power than that – they typically sport bright color screens that can crisply display words, pictures and animation. Many of these screens have resolutions of 320x240 pixels – half the screen size of the standard computer of not too long ago – and higher. They display thousands of colors and even 3D and holograms.

Such high-resolution screens allow for meaningful amounts of text to be displayed, either paragraph by paragraph, or flashed one quick word at a time, with the user setting (and generally greatly increasing) his or her own reading speed. In Asia, novels intended to be read on phone screens are already being written. Why not learning texts?

Better graphic displays also mean that such text can be accompanied with pictures and animation (and, of course, sound – it *is* a phone). Many schools are currently using computers and handheld devices for animations in subjects such as anatomy and forensics

– cell phones can replace these devices. Japanese students have long learned everything from business to cooking through graphic novels or "manga," which are now becoming popular in the West as well. At a recent computer show, a Japanese company was handing out a manga pamphlet about its "middleware" software, that could easily be displayed one frame at a time on a cell phone. So in many cases our mobile phones will replace our textbooks, with the limited screen size of the phones being, in fact, a positive constraint that forces publishers to re-think their design and logic for maximum effectiveness, rather than just adding pages.

Downloadable Programs

Now that cell phones have memories (or memory card slots) that accept downloaded programs and content, entire new learning worlds have opened up. Cell phone users can download versions of the same kinds of tools and teaching programs available on personal computers, and, given that the phones are communications devices, use the tools for collaboration in new and interesting ways. All manner of applications combining elements of voice, text, graphics, and even specially designed spreadsheets and word processors can be downloaded to the phones, with additional "content" added as needed. Need review in any subject? Want to practice for your Nursing Boards, GREs, or MCATs? Just download a program to your cell phone, call your friends, and start studying.

Internet Browser

Internet browsers are now being built in to a growing number of cell phones, especially those that use the faster "3G" (third generation) protocol. Web sites specifically designed for cell phones are becoming more and more numerous. A browser in the cell phone puts a dictionary, thesaurus, and encyclopedia instantly onto the hands of every student. It gives them instant access to Google and other text search engines, turning their cell phones into research tools. Students studying nature, architecture, art or design can search for images on the web that match what they find in life in order to understand their properties, style and criticism.

Cameras

Almost a million camera phones were sold last year, and in many places such phones are already accepted as the norm. Educationally – once students learn that privacy concerns are as important here as anywhere else – they are a gold mine. In class, cell phones with cameras are tools for scientific data collection, documentation, and visual journalism, allowing students to gather evidence, collect and classify images, and follow progressions over time. Creative cell phone photos can inspire students' creative writing via caption or story contests. Phones can be placed in various (appropriate) places, and operated remotely, allowing observations that would be impossible in person. We can literally see what's going on around the world, including, potentially, in "sister classrooms" in other countries.

Global Positioning Systems

The initial crude ability of cell phones to "know where they are" quickly became the basis of some very innovative applications abroad, including a multiplayer search game in the UK. Now sophisticated GPS satellite receivers are being built in to many cell phones (and made available as add-ons for many others) that know the phone's precise position to within a few feet.

This feature allows cell phone learning to be location-specific. Students' cell phones can provide them with information about whatever location they happen to be at in a city, countryside or campus. (Some colleges already use this feature for orientation.) The ability of students to determine their precise position has clear applications in geography, orienteering, archeology, architecture, science and math, to name only a few subjects. Cell phones with GPS can be used by students to search for things and places (already known as "geocaching"), and to pinpoint environmental dangers, as in a recent learning game from MIT.

Video Clips

Finally, as I write, the first video cam phones are hitting the market, capable of taking and sending short, typically 10-30 second, video clips. This extends the phone's learning possibilities even farther, into television journalism (most TV news clips are less than 30 seconds), as well as creative movie-making. A terrific educational use of short video clips would be for modeling effective and ineffective behaviors relating to ethics, negotiation, and other subjects.

Connections and Caveats

My main purpose in writing this article is that, having searched quite a bit, I have found the number of people using or researching learning via cell phones to be exceedingly small, particularly outside of Asia. (In Japan, Masayasu Morita, working with ALC Press, has found that, using the same content formatted differently for computers and cell phones, 90 percent of cell phone users were still using the system after 15 days compared to only 50 percent of the computer users (http://csdl.computer.org/comp/proceedings/c5/2003/1975/00/19750128.pdf). Another Japanese company, Cerego, is also very bullish on cell phones for learning.) While researchers such as Elliot Soloway and Eric Hopfer in the U.S., Jill Attenwell in Great Britain, and Georgio da Bormida in Italy are experimenting with "mobile devices" for learning, they typically are not using "cell phones" but rather PDAs, (which are often donated by manufacturers eager to find a new market for their devices.) But this is not the same, in my view, as using *cell phones* for learning. There are less than 50 million PDAs in the world but over 1.5 BILLION cell phones. Of course much PDA-based research will be useful, but it is not until we begin thinking of using the computing/communication device *currently in the students' pocket* for learning, that we will be on the right track.

As usual, the students are far ahead of us on this. As noted, the first use they have found (in large numbers) for putting their cell phones to use for learning is "retrieving information on demand during exams." Educators, of course, refer to this as "cheating." But they might better serve their students' education by redefining "open book" testing to "open phone", for example, and by encouraging, rather than quashing, student innovation in this and other areas. Just so that I am not misinterpreted, let me state that I am not "for" cheating. But I *am* for adjusting the rules of test-taking and other educational practices in a way that fosters student ingenuity and creativity in using their tools, and that supports learning rather than administration.

As these sorts of adjustments happen, new norms and ethics will have to emerge around technology in classrooms. But norms can change quickly when a new one is better. Perhaps you can remember how rapidly, in the 1970s, the norm went from "It's rude to have an answering machine" to "It's rude NOT to have an answering machine!"

Educators should bear in mind that cell phones can be used for context as well as content (as in the aforementioned tour of Lexington MA.) Those concerned that students use their tools not only to retrieve information but to filter and understand it are the very people who should be figuring out how to use cell phones to do this. Just as we are designing and refining Web and PC-based tools for such tasks, so must we be designing similar tools for the cell phones – and in doing so the communication and social features of the phones are likely to be of great help.

Fully-featured as they are, it has also been pointed out that cell phones are not powerful enough to be students' *only* learning tool. "Well Duh!," most students would say. "We'll use whatever tools do the job – just make sure they all work together!" Our cell phones can be our students' interface to a variety of computing devices, just as they control their entertainment devices.

Although I have tried to provide a variety of suggestions and examples as to how cell phones might be used for learning, my goal here is not to present a fully-completed vision, but rather to open the eyes of those who are ignoring an important resource for learning that is real and untapped today. I am sure many will extend the vision and possibilities for cell phones in learning, and I welcome all suggestions. I am convinced that once cell phone-based learning is under way, the "world mind" of both educators and students will take it in a million useful and unexpected directions.

The Future

Cell phones are getting smaller and more powerful each day. The disposable cell phone, a mere 2" x 3" with the thickness of three credit cards and made entirely of paper (the circuit board is printed with metallic conductive ink) is already patented and being manufactured. Such phones, in volume, will likely cost less than a dollar a piece, with the air time for educational uses likely subsidized by carriers and others.

Imagine teachers handing out a phone in every class preloaded with all the software and contact numbers for a class task or project. Or imagine the United Nations dropping millions of disposable, single-button cell phones over places in the world sorely in need of learning. Pick one up, push the button, and suddenly you are no longer part of the "digital divide" but part of a world learning community, with your connection costs paid for by those with a stake in making your learning happen. (A project of just this type is happening today for Afghan rural women, but using bulky, proprietary machines at fifty times the cost.) Of course "adverphones" will no doubt appear as well, and we will need, just as we do with other media, to help our students understand the difference.

Finally, despite complaints we often hear from older "Digital Immigrant" adults (with fading vision and manual dexterity) about cell phones' limited screen and button size, it is precisely the combination of miniaturization, mobility, and power that grabs today's Digital Natives. They can visualize a small screen as a window to an infinite space, and have quickly trained themselves to keyboard with their thumbs.

And despite what some may consider cell phones' "limitations," our students are already inventing ways to use their phones to learn what *they* want to know. If we educators are smart, we'll figure out how to deliver *our* product in a way that fits into our students' digital lives – and their cell phones. And instead of wasting our energy fighting their preferred delivery system, we'll be working to ensure that our students extract maximum understanding and benefit from the vast amounts of cell phone-based learning they will all, no doubt, soon be receiving.

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