The Horizon Project

2009 Horizon Report: Preview

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Time-to-Adoption: One Year or Less

Mobile

Over the past few years, mobiles have undergone a continual transformation, becoming more capable and flexible with each new release. The ability to record audio and video turned them into tiny multimedia devices; as storage capacity increased, they became the storehouses of our digital lives; and geolocation, web browsing, and email has brought much of the functionality of a laptop to the pocket-sized devices. Then, a year ago, another transformation took place. Devices with touch screen displays appeared on the market. These new mobiles can access the Internet over the increasingly higher-speed 3G networks or by using wifi, and they can sense motion and orientation and react accordingly thanks to built-in accelerometers. They can use GPS to locate themselves and can run robust applications. They communicate with other devices. Most significantly, their manufacturers are working with the developer community to open up the devices to all the innovation that third-party developers can bring.

New interfaces, the ability to connect to wifi and GPS in addition to a variety of cellular networks, and the availability of third-party applications have created an almost entirely new device with nearly infinite possibilities for education, networking, and personal productivity. Almost every student carries a mobile device, making it a natural choice for content delivery and even field work and data capture: mobiles and their networks are virtually everywhere. Language learners can install applications on their mobiles that let them look up words, practice hearing and speaking, and practice writing. Detailed reference materials are available for medicine and astronomy; graphing calculator applications turn mobiles into sophisticated mathematical tools; hundreds of flash card applications are available for an array of subjects; and Google Earth now can be installed on mobile devices. The implications for education are dramatic: the potential for mobile gaming and simulation, research aids, fieldwork, and tools for learning of all kinds is there, awaiting development.

Cloud Computing

The emergence of large "data farms" — specialized data centers that host thousands of servers — has created a surplus of computing resources that has come to be called the *cloud*. Aspects of computing that used to be considered expensive, like disk storage and computing cycles, are now becoming cheap and ubiquitous. Layered on top of the cloud infrastructure are development platforms that are enabling thin-client, web-based applications for everything from image editing to word processing to music and video manipulation. Specialized applications like Flickr live entirely in the cloud; there is no single computer, or even specific group of computers, that can be pointed to as housing Flickr, Google, or YouTube. To the end user, the cloud is invisible; the technology that supports the applications doesn't matter — the fact that the applications are always available is key.

There are three types of services associated with the cloud. The most straightforward set of services from an end-user perspective are cloud-based applications that serve a single function, such as Gmail (http://gmail.com) or Quicken Online (http://quicken.intuit.com/online-banking-finances.jsp). The next tier is one step removed from this: instead of offering end-user applications, these services offer the infrastructure on which to build such applications, along with the computing power to deliver them, like Google App Engine (http://code.google.com/appengine/) or Heroku (http://heroku.com). The final tier of cloud services are those that offer sheer computing resources without a development platform layer, like Amazon's Elastic Compute Cloud (http://aws.amazon.com/ec2/) or the GoGrid (http://www.gogrid.com). Cloud-based applications can provide students and teachers with free or low-cost alternatives to expensive, proprietary productivity tools, while the shared infrastructure approach imbedded in the cloud computing concept offers considerable potential for large scale experiments and research that can make use of untapped processing power.

Time-to-Adoption: Two to Three Years

Geo-Everything

Geolocation technology is not new, but it is now beginning to appear in an increasing range of common devices like mobile phones, cameras, and other handheld devices. Similarly, mapping geolocative data is not new; but the ability to easily create map mashups online using multimedia and geotagged data is. Now that geolocative data is becoming easy to capture and apply as tag data, we are beginning to see applications for research and learning that are quick and inexpensive but still very effective. Researchers can study migrations of animals, birds, and insects or track the spread of epidemics using data from a multitude of personal devices uploaded as geotagged photographs, videos, or other media plotted on readily-available maps. Many free or very low-cost tools to capture and display geolocative data are available online, and are much easier to use than previously.

Web services are beginning to make use of geolocative data in creative and useful ways. Radar (http://outside.in/radar) serves up local information like news, blog posts, restaurant reviews, and so on, based on a viewer's location. The service can determine a computer's location automatically based on IP address (if the user permits), allowing travelers to instantly get local information on their laptops wherever they may be. Buzzd (http://buzzd.com) is a city guide and social networking tool for mobile devices, including not only local information but also user ratings and tips.

Geolocation opens up opportunities for learning and data acquisition in the field for the sciences, social observation studies, and other disciplines. Mobile learners can receive context-aware information about nearby resources, points of interest, historical sites, and colleagues, connecting all this with online information for just-in-time learning. Relatively simple applications of geolocative data like these represent its earliest uses in websites and mobiles, but this cluster of technologies is developing very rapidly.

The Personal Web

Online publishing tools like blogs, Twitter, Tumblr, Facebook, and the like have become mainstream – certainly in terms of who reads them, and increasingly in terms of who writes to them. The ability to instantly publish, tag, and categorize work online, without the need to understand or even touch the underlying technologies provides a host of opportunities for faculty and students. Online publishing tools are being employed in the process of education as a means for personal and professional reflection, collaborative work, research, and the development of a public voice.

The same set of technologies is being harnessed to create highly flexible, unique personal learning environments: collections of tools individually selected to suit a learner's style and preferences. Open source learning tools that foster personal and social forms of learning and expression, though technically unrelated, work together seamlessly without any need for complicated setup.

Another kind of personal publishing is also beginning to gain popularity, and holds promise for education as well. Collaborative authoring of novels, comics, white papers, and even textbooks is supported by websites designed for the purpose. Some have a specifically educational focus, like Flat World Knowledge (http://www.flatworldknowledge.com). WeBook (http://www.webook.com) is aimed at the general public and includes everything from children's books to cookbooks. Most of these sites offer hardcopy publishing as well as online publishing.

Time-to-Adoption: Four to Five Years

Semantic-Aware Applications

The idea behind what people call the *semantic web* is that although the data is available for searching, its meaning is not: computers are very good at returning keywords, but very bad at understanding the context in which keywords are used. The vision for the semantic web, originally advanced by Tim Berners-Lee, is that eventually it might be able to help people solve very difficult problems by presenting connections between apparently unrelated concepts, individuals, events, or things – connections that it would take many people many years to perceive, but that could become obvious through the kinds of associations made possible by semantic applications.

There are currently two theoretical approaches to developing the semantic web. One, the bottom-up approach, is problematic in that it assumes metadata will be added to each piece of content to include information about its context. The top-down approach appears to have a far greater likelihood of success, as it focuses on developing natural language search capability that can make those same kinds of determinations without any special metadata.

New web applications are allowing meaning to be inferred from content and context. The promise of these semantic-aware applications is to help us see connections that already exist, but that are invisible to current search algorithms because they are embedded in the context of the information on the web.

Smart Objects

Beginning with radio-frequency identification (RFID) tags and smartcards, objects that carry information with them have been used for point-of-sale purchases, passport tracking, inventory management, and other uses. RFID tags and smartcards "know" about a certain kind of information, like how much money is available in a user's account and how to transfer the correct amount to a retailer for a given purchase, or which book is being checked out at a library.

Similarly, chips embedded in small household appliances "know" where they are located and can access local information: your coffeepot can tell you about the weather while you pour yourself a cup. The next step in smart object technology is just over the horizon: not only will objects know what and where they are, but they will also be able to sense and communicate with other objects, report and update their own status, and carry information about their entire history, from creation and distribution all the way through disposal.

Current applications for smart objects include wireless location of library materials, retrieval of lost or missing items, and tracking of material usage. The vision for smart object technology is a blending of the digital Internet with the physical world. With recent developments in mobile technology, it is not difficult to imagine mobile applications that tap into "the Internet of things," as this vision is called. Finding physical objects such as reference materials, household goods, or sports equipment could become as easy as finding information is now. The idea of tiny chips that communicate their location and other information raises evident questions about privacy and security, and the time when we will see them commonly used in educational settings is still distant, but smart object technology promises to transform the way we perceive and interact with physical objects – in time.

Critical Challenges

There is a growing need for formal instruction in key new skills, including information literacy, visual literacy, and technological literacy. The skills involved in writing and research have changed from those required even a few years ago. Students need to be technologically adept, to be able to collaborate with peers all over the world, to understand basic content and media design, and to understand the relationship between apparent function and underlying code in the applications they use daily. Questions of assessment and support of new literacies across the curriculum continue to surface.

Students are different, but a lot of educational material isn't. Schools are still using materials developed to teach the students of decades ago, but today's students are actually very different in the way they think and work. Institutions need to adapt to current student needs and identify new learning models that are engaging to younger generations. Assessment, likewise, has not kept pace with new modes of working, and must change along with teaching methods, tools, and materials.

Significant shifts are taking place in the ways scholarship & research are conducted, and a there is a need for innovation and leadership at all levels of the academy. Academic review and faculty rewards are increasingly out of sync. Clear practices for assessing emerging forms of scholarly practice are needed for tenure and promotion. Students who are living and learning with technologies that generate dynamic forms of content may find the current formalism and structure of scholarship and research to be static and "dead" as a way of collecting, analyzing and sharing results.

We are expected, especially in public education, to measure and prove though formal assessment that our students are learning. Data collection and mining of student information systems will be required for accreditation, and institutions will need to be able to collect, manage, sort, and retrieve data of all kinds. The systems currently in place are not capable of managing electronic data on the scale that is anticipated.

Higher education is facing a growing expectation to make use of and to deliver services, content, and media to mobile devices. This challenge is even more true today than it was when it first appeared in the *Horizon Report* two years ago. As new devices continue to make content almost as easy to access and view on a mobile as on a computer, and as ever more engaging applications take advantage of new interface technologies like accelerometers and multi-touch screens, the applications for mobiles continue to grow. This is more than merely an expectation to provide content: this is an opportunity for higher education to reach its constituents in new and compelling ways, in addition to the obvious anytime, anywhere benefits of these ubiquitous devices.

Key Trends

Increasing globalization continues to affect the way we work, collaborate, and communicate. Information technologies impact how people work, play, gain information, and participate in communities. Increasingly, those who can use the technologies to a greater extent are more likely to advance, while those without access or skills lose out. The digital divide used to be seen as an "earning divide" but is now more of a "learning divide," with those who have access to education in a better position to obtain and make use of technology than those who do not. On an institutional level, there is a financial impact to consider in terms of whether to open brick-and-mortar campuses in other countries, or try to extend the reach of home campuses through technology (or both).

The notion of collective intelligence is redefining how we think about ambiguity and imprecision. Collective intelligence may give rise to multiple answers, all equally correct, to problems. The notions of collective intelligence and mass amateurization are redefining scholarship as we grapple with issues of top-down control and grassroots scholarship. Today's learners want to be active participants in the learning process – not mere listeners; they have a need to control their environments, and they understand that content and knowledge is available at their fingertips.

Gaming is an increasingly universal phenomenon among those entering higher education and the workforce. A recent survey by the Pew Internet and American Life Project (http://www.pewinternet.org/PPF/r/263/report_display.asp) found that the gaming experience is common among young people, is rich and varied, and includes opportunity for social interaction and civic engagement. The success of gaming tells us that current educational methods are not engaging students enough. Gaming calls for active participation and interaction; these qualities need to be infused into learning processes and environments.

Visualization tools are making information more meaningful and insights more intuitive. As tools of this nature continue to be developed and used, visual literacy will become an increasingly important skill in decoding, encoding, and determining credibility and authenticity of data. Visual literacy must be formally taught, but it is an evolving field even now.

As more than one billion phones are produced each year, mobile phones are benefiting from unprecedented innovation, driven by global competition. New capabilities in terms of hardware and software are turning mobiles into indispensible tools. Third-party applications, now available on several models of mobile devices, expand their utility even further. This trend, observed in the *Horizon Report* now for some time, will continue to generate long-term impacts on the ways we communicate and view computing and networked resources.