NMC Horizon Project Short List
2013 Higher Education Edition
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Flipped Classroom

The flipped classroom refers to a model of learning that rearranges how time is spent both in and out of class to shift the ownership of learning from the educators to the students. After class, students manage the content they use, the pace and style of learning, and the ways in which they demonstrate their knowledge, and the teacher becomes the guide, adapting instructional approaches to suit their learning needs and supporting their personal learning journeys. Rather than the teacher using class time to lecture to students and dispense information, that work is done by each student after class, and could take the form of watching video lectures, listening to podcasts, perusing enhanced e-book content, collaborating with their peers in online communities, and more. Students can access this wide variety of resources any time they need them. In the flipped classroom model, valuable class time is devoted to more active, project-based learning where students work together to solve local or global challenges — or other real-world applications — to gain a deeper understanding of the subject. Teachers can also devote more time interacting with each individual. The goal is for students to learn more authentically by doing, with the teacher guiding the way; the lecture is no longer the expected driver of concept mastery. The flipped classroom model is part of a larger pedagogical movement that overlaps with blended learning, inquiry-based learning, and other instructional approaches and tools that are meant to be flexible, active, and more engaging for students. It has the potential to better enable educators to design unique and quality learning opportunities, curriculum, and assessments that are more personal and relevant to students’ lives.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- Flipped classroom concepts and the idea of providing the student with a more diverse set of learning resources can support self-directed learning.
- More active learning is an important component of the flipped classroom: lectures can be watched with ensuing online discussions unfolding at home, professors can use class time for hands-on activities or trips outside of the building.

Flipped Classroom in Practice

- A chemistry professor at Ohio State University is implementing a flipped classroom model using iTunes U to dedicate class time to collaborative problem-solving: go.nmc.org/zbaaj
- Graduate and senior undergraduate students at Boston University are learning Computational Fluid Dynamics through a flipped classroom model: go.nmc.org/uanyu.
- Lassen Community College is adopting a flipped classroom model that includes independent study, distance and virtual learning, and one-to-one tutoring: go.nmc.org/act.

For Further Reading

The Flipped Class Manifest
go.nmc.org/kwwtp
(Brian E. Bennett, Jon Bergmann, et al, The Daily Riff, 9 July 2012.) Advocates of the flipped classroom explain what flipped classroom looks like and how this method of learning works with other instructional tools and styles such as podcasting and project-based learning.

What is The Flipped Classroom Model And Why Is It Amazing?
go.nmc.org/psxke
(Pascual-Emmanul Gobry, Forbes, 11 December 2012.) A contributor for Forbes responds with his own analysis to a thoroughly researched infographic that presents the arguments for and against the flipped classroom model.

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Time-to-Adoption: One Year or Less
Massively Open Online Courses

When Stephen Downes and George Siemens coined the term in 2008, massively open online courses (MOOCs) were conceptualized as the next evolution of networked learning. The essence of the original MOOC concept was a web course that people could take from anywhere across the world, with potentially thousands of participants. The basis of this concept is an expansive and diverse set of content, contributed by a variety of experts, educators, and instructors in a specific field, aggregated into a central repository, such as a web site. What made this content set especially unique is that it could be “remixed” — the materials are not necessarily designed to go together but become associated with each other through the MOOC. A key component of the original vision is that all course materials and the course itself are open source and free — with the door left open for a fee if a participant taking the course wished university credit to be transcripted for the work. Since those early days, interest in MOOCs has evolved at an unprecedented pace, fueled by high profile entrants like Coursera, Udacity, and edX. In these examples, the notion has shifted away from open content or even open access, to an interpretation in which “open” equates to “no charge.” The pace of development in the MOOC space is so high that it is likely that a number of alternative models will emerge in the coming year. Ultimately, the models that attract the most participants are gaining the most attention, but many challenges remain to be resolved in supporting learning at scale.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- As new pedagogies emphasize personalized learning, there is a growing demand for learner-centered online courses for the masses; MOOCs, when designed effectively, have the potential to scale globally.
- Many MOOCs allow learners of all ages, incomes, and levels of education to participate in a wide array of courses without being enrolled in the physical institution.
- MOOCs make creative use of several educational technologies and emerging instructional approaches, including blended learning, video lectures, and badges.

Massively Open Online Courses in Practice

- The Centro Superior para la Enseñanza Virtual is encouraging MOOC enrollment to Latin American communities through a Spanish platform called unX: go.nmc.org/gyorb.
- Coursera, a start-up by two Stanford University professors, offers hundreds of free online courses, including bioelectricity and cryptography: go.nmc.org/course.
- edX offers a variety of free courses to a global, virtual community of students that can be taken on their own or to supplement classes on the physical campus: go.nmc.org/mitx.

For Further Reading

College Is Dead. Long Live College!
go.nmc.org/ylazv
(Amanda Ripley, TIME, 18 October 2012.) When the Pakistani government shut down access to YouTube in September 2012, an 11-year old girl connected with U.S. students and found a solution to continue her online studies with Udacity.

How ‘Open’ Are MOOCs?
go.nmc.org/ope
(Steve Kolowich, Inside Higher Ed, 8 November 2012.) This article explores several misunderstandings in the way many chief academic officers view massively open online courses and their potential to supplement traditional university classes.
Time-to-Adoption: One Year or Less

Mobile Apps

There is a revolution that is taking place in software development that parallels the changes in recent years in the music, publishing, and retail industries. Mass market is giving way to niche market, and with it, the era of highly priced large suites of integrated software has shifted to a new view of what software should be. Smartphones such as the Galaxy, 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. New tools are free or sell for as little as 99 cents. A popular app can see millions of downloads in a very short time, and that potential market has spawned a flood of creativity that is instantly apparent in the extensive collections available in the app stores. These retail phenomena provide an easy, fast, and totally new way to deliver software that reduces distribution and marketing costs significantly. Apple’s app store opened in July 2008; Google’s followed in October of that year. By September 2012, more than 55 billion apps had been sold or downloaded; simple but useful apps have found their way into almost every form of human endeavor. Mobile apps are particularly useful for learning as they enable people to learn and experience new concepts wherever they are, often across multiple devices.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- Many disciplines now have mobile apps dedicated to deeper exploration of specific subjects, from the elements of the periodic table to the histories of art movements.
- Mobile apps facilitate content creation through the use of cameras, microphones, and other sensors and tools that are inherent in many smartphones.
- More universities have developed apps that share real-time grade information with students, along with maps, news, and other features that better connect learners to their campus.

Mobile Apps in Practice

- Engineering students at the University of New South Wales used the “Rubrik” app to help them collect real-time data in a marketing design project competition: go.nmc.org/rubrik.
- In addition to campus-related news, New York University’s mobile app integrates features that help students search for jobs and service opportunities: go.nmc.org/zuvjc.
- Open University in the UK is developing a suite of mobile apps that are compatible with many platforms and devices to deliver course content to undergraduates: go.nmc.org/ouany.

For Further Reading

23 Mobile Apps Educators Should Watch in 2013
go.nmc.org/wat

(Davide Savenije, Education Dive, 13 December 2012.) From scanning documents on-the-go to creating presentations, this article explores some of the most effective, multipurpose apps for teaching and learning.

Research Shows Mobile Apps Help Students Learn
go.nmc.org/emadx

(David Ottallini, University of Maryland News Desk, 28 August 2012.) A study from the University of Maryland found that mobile apps enhanced learning experiences for students.

Why Care About STEM? The Future of Mobile App Development
go.nmc.org/zkdal

(Sam Morris, Tablets at Work, 16 February 2012.) This article describes the potential of mobile app development to promote STEM fields by engaging learners in project-based learning.
Time-to-Adoption: One Year or Less

Tablet Computing

In the past two years, advances in tablets have captured the imagination of educators around the world. Led by the incredible success of the iPad, which at the time of publication had sold more than 85 million units and is predicted by GigaOM to sell over 377 million units by 2016, other similar devices such as the Samsung Galaxy Nexus, Kindle Fire, the Nook, Sony’s Tablet S, and the Microsoft Surface have also entered this rapidly growing market. In the process, the tablet (a form that does not require a mouse or keyboard) has come to be viewed as a new technology in its own right, one that blends features of laptops, smartphones, and earlier tablet computers with always-connected Internet, and thousands of apps with which to personalize the experience. As these new devices have become more used and understood, it has become even clearer that they are independent and distinct from other mobile devices such as smartphones, e-readers, or tablet PCs. With significantly larger screens and richer gesture-based interfaces than their smartphone predecessors — and a growing and ever more competitive market — they are ideal tools for sharing content, videos, images, and presentations because they are easy for anyone to use, visually compelling, and highly portable.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- Tablets are easily adaptable to almost any learning environment, with tens of thousands of educational applications emerging as part of a new software distribution model.
- As a one-to-one solution, tablets present an economic, flexible alternative to laptops and desktops due to their lower cost, greater portability, and access to apps.
- Tablets are conducive to learning outside of the classroom, with a suite of tools for capturing data in real-time and collaborating on projects.

Tablet Computing in Practice

- Duke University has been exploring the use of the iPad as an efficient way to collect global health research in the field. They have allowed students in low-resource settings to capture data using just one device: go.nmc.org/fqxpm.
- In organic chemistry laboratories at the University of Illinois at Urbana-Champaign, wall-mounted iPads contain an app that delivers video reviews of lab techniques: go.nmc.org/hjjvi.
- Seton Hill University’s “iPad on the Hill” program allows all full-time students and faculty to receive their own iPad to use both on and off campus: go.nmc.org/seton.

For Further Reading

Here Come Tablets. Here Come Problems.
go.nmc.org/tablets
(Shara Tibken, The Wall Street Journal, 2 April 2012.) This article addresses the biggest mistakes that organizations make in adopting tablets and what can be learned from them.

How the iPad is Changing Education
go.nmc.org/ipadis
(John Paul Titlow, Read Write Web, 22 April 2012.) Several years after the launch of the iPad, institutions share the outcomes of their implementation studies.

Why Tablet Publishing Is Poised to Revolutionize Higher Education
go.nmc.org/whytab
(Trevor Bailey, Mashable, 6 January 2012.) Fostering better study habits and more interactive learning are cited among the reasons tablets are powerful tools in higher education.
Augmented Reality

Augmented reality (AR), a capability that has been around for decades, has shifted from what was once seen as a gimmick to a tool with tremendous potential. The layering of information over 3D space produces a new experience of the world, sometimes referred to as “blended reality,” and is fueling the broader migration of computing from the desktop to the mobile device, bringing with it new expectations regarding access to information and new opportunities for learning. While the most prevalent uses of augmented reality so far have been in the consumer sector (for marketing, social engagement, amusement, or location-based information), new uses seem to emerge almost daily, as tools for creating new applications become even easier to use. A key characteristic of augmented reality is its ability to respond to user input, which confers significant potential for learning and assessment; with it, learners can construct new understanding based on interactions with virtual objects that bring underlying data to life. Dynamic processes, extensive datasets, and objects too large or too small to be manipulated can be brought into a learner’s personal space at a scale and in a form easy to understand and work with.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- Augmented reality has strong potential to provide powerful contextual, in situ learning experiences and serendipitous exploration as well as the discovery of the connected nature of information in the real world.
- Games that are based in the real world and augmented with networked data can give educators powerful new ways to show relationships and connections.
- Students visiting historic sites can access AR applications that overlay maps and information about how the location looked at different points in history.

Augmented Reality in Practice

- Boise State University uses an interactive, online resource called AnatomyTV, which provides real-time 3D modeling of the human anatomy. More than 7,500 structures produced from medical scan data can be rotated, shown in opaque and x-ray, and more: go.nmc.org/ana.
- The University of Exeter built an augmented reality mobile app that transforms the campus into a living lab, where users can view scientific data about their surroundings: go.nmc.org/lluvuv.
- The University of Washington partnered with Microsoft to develop augmented reality contact lenses that could potentially monitor the vital signs of the wearer: go.nmc.org/ixjhf.

For Further Reading

How to Augment Your Reality with AR
/go.nmc.org/funig

(Margriet Schavemaker, edgital, 12 October 2012.) The author of this post discusses how to make a custom augmented reality learning experience, particularly in a large-scale environment.

The World Is Not Enough: Google and the Future of Augmented Reality
/go.nmc.org/yvgbu

(Alexis C. Madrigal, The Atlantic, 25 October 2012.) Between Google Glass and the Field Trip app, Google is incorporating augmented reality into new tools. This article discusses the importance of determining what digital content is important enough to be overlaid in our daily physical spaces and in what manner or medium the information should be displayed.
Game-Based Learning

Game-based learning refers to the integration of games or gaming mechanics into educational experiences. This topic has gained considerable traction over the past decade as games have proven to be effective learning tools, and beneficial in cognitive development and the fostering of soft skills among learners, such as collaboration, communication, problem-solving, and critical thinking. The forms of games grow increasingly diverse and some of the most commonly used for educational purposes include alternate reality games (ARG), massively multiplayer online games (MMO), and global social awareness games. Most games that are currently used for learning across a wide range of disciplines share similar qualities: they are goal-oriented; have strong social components; and simulate some sort of real world experience that people find relevant to their lives. As game-based learning garners more attention, developers are responding with games expressly designed to support immersive, experiential learning.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- Discovery-based and goal-oriented learning are often inherent in educational games, fostering opportunities for collaboration and the development of teambuilding skills.
- Educational games can be used to teach cross-curricular concepts that touch on many subjects in a more engaging way than traditional methods.
- Simulations and role-playing games allow students to re-enact difficult situations to try new responses or pose creative solutions.

Game-Based Learning in Practice

- The Global Social Problems, Local Action & Social Networks for Change project at St. Edward’s University positioned learners in the role of superheroes to tackle large-scale global social problems at local levels: go.nmc.org/cjqog.
- McGill University’s Open Orchestra simulation game uses high definition panoramic video and surround sound to provide musicians with the experience of playing in an orchestra or singing in an opera: go.nmc.org/canar.
- The University of Bahia’s Games and Education initiative supports collaborative, scholarly research and publications about educational gaming: go.nmc.org/gamesa.

For Further Reading

18 Graduate Programs Embracing Games

go.nmc.org/game

(Online Universities, 7 November 2012.) This article shares how games that model real-life scenarios are cost-effective ways for students to gain valuable experience and skills.

Motivating Students and the Gamification of Learning

go.nmc.org/gamhie

(Shantanu Sinha, The Huffington Post, 14 February 2012.) The president of the Khan Academy explores effective ways to integrate gaming mechanics into education.

Taking a Cue from Video Games, a New Idea for Therapy

go.nmc.org/taking

(Hayley Tsukayama, The Washington Post, 17 October 2012.) Games could play a positive role in supporting war veterans by providing positive, practical goals. This has implications for many higher education areas of study, including psychology.
The Internet of Things

The Internet of Things has become a sort of shorthand for network-aware smart objects that connect the physical world with the world of information. A smart object has four key attributes: it is small, and thus easy to attach to almost anything; it has a unique identifier; it has a small store of data or information; and it has a way to communicate that information to an external device on demand. The Internet of Things extends that concept by using TCP/IP as the means to convey the information, thus making objects addressable (and findable) on the Internet. Objects that carry information with them have long been used for the monitoring of sensitive equipment or materials, point-of-sale purchases, passport tracking, inventory management, identification, and similar applications. Smart objects are the next generation of those technologies — they “know” about a certain kind of information, such as cost, age, temperature, color, pressure, or humidity — and can pass that information along easily and instantly upon electronic request. They are ideal for digital management of physical objects, monitoring their status, tracking them throughout their lifespan, alerting someone when they are in danger of being damaged or spoiled — or even annotating them with descriptions, instructions, warranties, tutorials, photographs, connections to other objects, and any other kind of contextual information. The Internet of Things would make access to these data as easy as it is to use the web.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- Attached to scientific samples, TCP/IP-enabled smart objects already are alerting scientists and researchers to conditions that may impair the quality or utility of the samples.
- Pill-shaped microcameras are used in medical diagnostics and teaching to traverse the human digestive tract and send back thousands of images to pinpoint sources of illness.
- TCP/IP enabled sensors and information stores make it possible for geology and anthropology departments to monitor or share the status and history of even the tiniest artifact in their collections of specimens from anywhere to anyone with an Internet connection.

The Internet of Things in Practice

- Engineering graduates are being recruited by General Electric to join their computer scientists and software developers in an effort to build and "industrial Internet:" go.nmc.org/rcxip.
- MIT’s Amarino is a toolkit that allows smartphone users to control the lights in a room and detect exposure levels to potentially harmful environmental factors: go.nmc.org/uyllx.
- Sigfox created an inexpensive network using ultra narrowband that can enable thousands of low-power sensors and devices to communicate data instantly: go.nmc.org/sig.
- Twine by Supermechanical is a small, Internet-connected device that monitors environments and alerts users to anything from basement flooding to finished laundry: go.nmc.org/twine.

For Further Reading

Futurist’s Cheat Sheet: Internet of Things

go.nmc.org/cpfez

(Dan Rowinski, Read Write Web, 31 August 2012.) The author explores a world where objects have their own IP addresses and communicate with each other via WiFi or cellular networks.

The Internet of Things: How It’ll Revolutionise Your Devices

go.nmc.org/devi

(Jamie Carter, Tech Radar, 4 July 2012.) This article discusses the potential of sensors and smart objects to monitor and respond in ways that take over some of the frustrating tasks of daily life like grocery shopping and to make it possible for our gadgets to self-repair.
Learning analytics refers to the interpretation of a wide range of data produced by and gathered on behalf of students to assess academic progress, predict future performance, and spot potential issues. Data are collected from explicit student actions, such as completing assignments and taking exams, and from tacit actions, including online social interactions, extracurricular activities, posts on discussion forums, and other activities that are not typically viewed as part of a student’s work. The goal of learning analytics is to enable teachers and schools to tailor educational opportunities to each student’s level of need and ability. Learning analytics promises to harness the power of advances in data mining, interpretation, and modeling to improve understanding of teaching and learning, and to tailor education to individual students more effectively. Still in its early stages, learning analytics is an emerging scientific practice that hopes to redefine what we know about learning by mining the vast amount of data produced by students in academic activities.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- If used effectively, learning analytics can help surface early signals that indicate a student is struggling, allowing teachers and schools to address issues quickly.
- Learning analytics draws pattern matching and analysis techniques from science courses offered at institutions, such as fluid dynamics and petroleum engineering.
- The promise of learning analytics is that when correctly applied and interpreted, it will enable teachers to more precisely identify students’ learning needs and tailor instruction appropriately.

Learning Analytics in Practice

- CourseSmart Analytics tracks students as they read e-books so that the professor can monitor and track how students are connecting with the course material: go.nmc.org/coana.
- In a pilot project at the University of Kentucky, learning analytics were used to measure and improve collaborative writing for computer science students: go.nmc.org/xzifk.
- Learning analytics were used at the Graduate School of Medicine at the University of Wollongong to help design a new curriculum with a clinical focus: go.nmc.org/zgxnk.

For Further Reading

Big Data for Education: Data Mining, Data Analytics, and Web Dashboards
go.nmc.org/hcvwt
(Brookings Institution, 4 September 2012.) This report explains how learning software can collect data and provide instant feedback to teachers and students.

Enhancing Teaching and Learning through Educational Data Mining and Learning Analytics
go.nmc.org/datmin

Learning and Knowledge Analytics
go.nmc.org/igyjh
(George Siemens; accessed 11 December 2012.) Renowned learning analytics expert George Siemens frequently updates this website with his insights on the topic, from keynotes to presentations, to blog posts.
Time-to-Adoption: Four to Five Years

3D Printing

Known in industrial circles as rapid prototyping, 3D printing refers to technologies that construct physical objects from three-dimensional (3D) digital content such as computer-aided design (CAD), computer aided tomography (CAT), and X-ray crystallography. A 3D printer builds a tangible model or prototype from the file, one layer at a time, using an inkjet-like process to spray a bonding agent onto a very thin layer of fixable powder. The bonding agent can be applied very accurately to build an object from the bottom up, layer by layer. The process even accommodates moving parts within the object. Using different powders and bonding agents, color can be applied, and prototype parts can be rendered in plastic, resin, or metal. This technology is commonly used in manufacturing to build prototypes of almost any object (scaled to fit the printer, of course) — models, plastic and metal parts, or any object that can be described in three dimensions.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- The exploration of the 3D printing process from design to production, as well as demonstrations and participatory access, can open up new possibilities for learning activities.
- Through replication, 3D printing allows for more authentic exploration of objects that may not be readily available to universities, including animal anatomies and toxic materials.
- Typically, geology and anthropology students are not allowed to handle fragile objects like fossils and artifacts; 3D printing shows promise as a rapid prototyping and production tool, providing users with the ability to touch, hold, and even take home an accurate model.

3D Printing in Practice

- The Fab Lab program was started in the Media Lab at MIT as a learning and maker space for digital fabrication, equipped with laser cutters, 3D printers, circuit boards and more, and the project has now scaled to create labs all over the world: go.nmc.org/fablab.
- Researchers at the University of Warwick created an inexpensive, 3D printable, electrically conductive plastic that enables electronic tracks and sensors as part of the 3D printed model: go.nmc.org/3dp.
- Thingiverse is a repository of digital designs for physical objects where users can download the digital design information and create that object themselves: go.nmc.org/thingv.

For Further Reading

7 Educational Uses for 3D Printing
go.nmc.org/7ed3d

(Nancy Parker, Getting Smart, 14 November 2012.) There is a vast array of uses for 3D printers in education, including drafting in architecture courses, creating 3D art in graphic design, developing body part models for biology, and more.

Making it real with 3D printing
go.nmc.org/making

(Drew Nelson, InfoWorld, 11 December 2012.) This article highlights the emergence of open source 3D printers, which got their start in 2007, and have now developed into lower costing more efficient models as users share, copy, and improve upon the model designs.

Science in Three Dimensions: The Print Revolution
go.nmc.org/lescx

(Kurzweil, 5 July 2012.) This article brings to light the capabilities of 3D printers for scientific research, and the way they are democratizing the ability to create custom models.
Time-to-Adoption: Four to Five Years

Flexible Displays

When organic light emitting diode displays (OLED) proliferated mass markets in 2004, consumers found that the new screens were lighter, brighter, and more energy efficient. In contrast to traditional glass-based LCD units, these new displays could be manufactured on thin, pliable plastics, prompting the term “flexible displays.” The popularity of OLED screens is largely due to their electroluminescence, which makes for more readable displays, an asset that has greatly influenced the popularity of e-readers such as the Kindle. The arrival of the world’s thinnest OLED display in 2008 by Samsung introduced a screen that was pliable and could easily be folded — features that gave rise to the ideas of unbreakable smartphones and bendable tablets. By 2009, popular news outlets including CBS and Entertainment Weekly were including “video in print” inserts in smaller circulations of their magazines, demonstrating the new technology. In late 2012, LG, Samsung, and Philips, among other major players in the electronics industry, announced plans for mass-producing flexible displays by 2013, and Apple has followed with the news of its own patent on a pliable display. As flexible displays gain traction in the consumer market, researchers, inventors, and developers are experimenting with possible applications for teaching and learning. Opportunities offered by flexible OLED screens in educational settings are being considered for e-texts, e-readers, and tablets. Additionally, flexible displays can wrap around curved surfaces, allowing for the possibility of smart tables and desks.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- Flexible screens can easily be attached to objects or furniture, regardless of their shape, and can even be worn — making them far more adaptable and portable than standard computer screens and mobile devices.
- Prototypes for flexible displays in the form of “e-paper” that can be crumbled up and discarded just like real paper may cause e-book manufacturers and others to rethink the construction and applications of digital textbooks and e-readers.

Flexible Displays in Practice

- In partnership with E Ink Corporation, Queen’s University and Arizona State University developed a prototype for a flexible paper-like computer: go.nmc.org/eoyye.
- Researchers at Arizona State University’s Flexible Display Center worked toward developing a lightweight display for soldiers that could show data, including maps: go.nmc.org/voqne.

For Further Reading

Amazing Screen Technology: Samsung Flexible AMOLED (Video)
go.nmc.org/samsu
(YouTube.com, 4 December 2011.) This video from Samsung reveals a smartphone/tablet hybrid with a clear display that layers a user’s entire desktop over their physical surroundings and can be folded up like a newspaper.

Bend Me, Shape Me: Flexible Phones ‘Out by 2013’
go.nmc.org/fle
(Katia Moskvitch, BBC News, 29 November 2012.) There is an array of options for flexible mobile devices as companies including LG, Philips, Sharp, Sony, and Nokia plan releases for 2013.

LG to Mass-Produce Flexible Displays
ogo.nmc.org/bcfhw
(Kim Yoo-chul, The Korea Times, 23 August 2012) LG announced that the company is going to produce flexible OLED displays in the coming year, which will directly compete with Samsung.
**Time-to-Adoption: Four to Five Years**

**Next Generation Batteries**

Two long-term trends are converging to make it possible for the first time to imagine batteries that charge incredibly quickly, last for days, and can be recharged thousands of times with no loss of efficiency. The first of these trends is in the development of low-power-consumption processors, LED lights, and other high-efficiency technologies. Coupled with a recurring cycle of advances in lithium battery technology, this is resulting in devices that require less power and have significantly longer-lasting, high-efficiency batteries. Among these are advances that are improving the safety of lithium technology while increasing the capacity of the batteries using it, such as solid state and polymer batteries. While the impact of such a technology on learning is currently challenging to measure, it is easy to imagine that as users feel less of a need to be tethered to power supplies, they will be using their devices more — anywhere they want.

**Relevance for Teaching, Learning, Research, or Creative Inquiry**

- The ability to recharge a device in minutes will mean that loaner equipment can be placed back into service very rapidly.
- Long-lasting batteries will enable more kinds of portable sensors, recorders, and other devices to be placed in remote locations for all manner of field studies.
- Next generation batteries have the potential to help untether devices and increase the uptake of mobile learning; as device processing power becomes more sophisticated, the notion of bring your own device could also evolve to include “bring your own power.”

**Next Generation Batteries in Practice**

- Chemists from The City College of New York along with researchers from Rice University and the U.S. Army Research Laboratory developed a non-toxic and sustainable lithium-ion battery, made with a natural plant dye to power mobile devices and electric vehicles: go.nmc.org/gre.
- Grafoid Inc. is working with Hydro-Quebec’s Research Institute on the development of next generation rechargeable batteries, using graphene and lithium iron phosphate materials to make rechargeable batteries for automobiles, mobile devices, and laptops: go.nmc.org/gra.

**For Further Reading**

**National Labs Leading Charge on Building Better Batteries**

(go.nmc.org/natlabs) Scientists at Oak Ridge National Laboratory incorporated a form of the compound titanium dioxide into lithium batteries and found significant improvements. Concurrently, Berkley Lab researchers designed a new anode made of millions of repeating units, giving the battery greater capacity.

**Polymer Batteries for Next-Generation Electronics**

(go.nmc.org/polyme) A new polymer gel developed by scientists at the University of Leeds could replace the liquid electrolytes currently used in rechargeable lithium battery cells for laptops, digital cameras, mobile phones, and more.

**When Will Your Phone Battery Last as Long as Your Kindle?**

(go.nmc.org/bat) As new and improved smartphones hit the market, there is still a lack of major improvements in battery life. This article describes the ways researchers are revamping the current lithium-ion battery and developing alternatives.
Wearable Technology

Wearable technology refers to devices that can be worn by users, taking the form of an accessory such as jewelry, sunglasses, a backpack, or even actual items of clothing like shoes or a jacket. The benefit of wearable technology is that it can conveniently integrate tools, devices, power needs, and connectivity within a user’s everyday life and movements. Google's Project Glass features one of the most talked about current examples — the device resembles a pair of glasses but with a single lens. A user can see information about their surroundings displayed in front of them, such as the names of friends who are in close proximity, or nearby places to access data that would be relevant to a research project. Wearable technology is still very new, but one can easily imagine accessories such as gloves that enhance the user’s ability to feel or control something they are not directly touching. Wearable technology already in the market includes clothing that charges batteries via decorative solar cells, allows interactions with a user’s devices via sewn-in controls or touch pads, or collects data on a person’s exercise regimen from sensors embedded in the heels of their shoes.

Relevance for Teaching, Learning, Research, or Creative Inquiry

- Smart jewelry or other accessories could alert wearers to hazardous conditions, such as exposure to carbon monoxide.
- Wearable devices and cameras can instantly capture hundreds of photographs or data about a user’s surroundings that can be later accessed via email or other online application.
- Wearable technology can automatically communicate information via text, email, and social networks on behalf of the user, based on voice commands, gestures, or other indicators.

Wearable Technology in Practice

- Keyglove is a wireless, open-source input device a user wears over the hand to control devices, enter data, play games, and manipulate 3D objects: go.nmc.org/fylwm.
- Memoto is a tiny, GPS-enabled camera that clips to a user’s shirt collar or button and takes two five-megapixel photographs per minute and uploads them to social media platforms: go.nmc.org/enzht.
- Researchers at the University of South Carolina converted the fibers of a t-shirt into activated carbon, turning it into electrical storage with the capacity to charge mobile devices: go.nmc.org/zscll.
- The University of Illinois at Urbana-Champaign designed a flexible circuit to enhance surgical gloves and improve sensory response: go.nmc.org/hwcpi.

For Further Reading

Wearable Tech Pioneers Aim to Track and Augment our Lives
go.nmc.org/wea

(Jane Wakefield, BBC News, 17 October 2012.) This article highlights the potential of wearable technology, including cameras that automatically snap photos, watches that sync with email accounts to display emails and reminders, and more.

Wearable Technology: A Vision of the Future?
go.nmc.org/sxqxs

(Charles Arthur, The Guardian, 18 July 2012.) Though tools such as smart glasses increase our connectedness to our surroundings, they raise the privacy concerns.
Key Trends

The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators. Institutions must consider the unique value that each adds to a world in which information is everywhere. In such a world, sense-making and the ability to assess the credibility of information are paramount. Mentoring and preparing students for the world in which they will live and work is again at the forefront. Universities have always been seen as the gold standard for educational credentialing, but emerging certification programs from other sources are eroding the value of that mission daily.

Assessment and accreditation are changing to validate life-long learning. The traditional degree, with its four-year time commitment and steep price tag, corresponded more logically with the model where the university was positioned as the central aggregator of top academic minds with residency-based students. Online education and new learning models are proliferating, causing the burden of logistics and infrastructure to be greatly reduced, while allowing for the potential of fluid, life-long education ecosystems. As a result, new initiatives are being developed that invent and accommodate different forms of assessment and accreditation. Badges, for example, are an alternative way to show reflections of learning, such as the mastery of a specific skill or participation in certain courses.

Both formal and informal learning experiences are becoming increasingly important as college graduates continue to face a highly competitive workforce. Informal learning generally refers to any learning that takes place outside of a formal school setting, but a more practical definition may be learning that is self-directed and aligns with the student’s own personal learning goals. Employers have specific expectations for new hires, including communication and critical thinking skills — talents that are often acquired or enhanced through informal learning. Online or other modern environments are trying to leverage both formal and informal learning experiences by giving students more traditional assignments, such as textbook readings and paper writing, in addition to allowing for more open-ended, unstructured time where they are encouraged to experiment, play, and explore topics based on their own motivations. This type of learning will become increasingly important in learning environments of all kinds.

Education entrepreneurship is booming. Many established companies and start-ups are launching.edu sites dedicated to providing capital funding to academic projects and ideas. At the university level, there is now more of an emphasis being placed on students creating something tangible in their courses, from mobile apps to long-lasting batteries and all sorts of lucrative innovations. The potential result, if these programs are managed and executed effectively, is the cultivation of learners as entrepreneurs that demonstrate their knowledge and concept mastery in profound ways to solve local and global problems. Real innovation can be achieved as an undergraduate or graduate student before they ever enter the workforce. Students become equipped with skills that could otherwise take years of working, post-university, to master. The inherent issue that will need to be addressed as this trend continues is determining precisely who is benefiting from this entrepreneurship and how it can be shaped to positively impact the student.

Education paradigms are shifting to include online learning, hybrid learning, and collaborative models. Budget cuts have forced institutions to re-evaluate their education strategies and find alternatives to the exclusive face-to-face learning models. Students already spend much of their free time on the Internet, learning and exchanging new information — often via their social networks. Institutions that embrace face-to-face/online hybrid learning models have the potential to leverage the online skills learners have already developed independent of academia. We are beginning to see developments in online learning that offer different affordances than physical campuses, including
opportunities for increased collaboration while equipping students with stronger digital skills. Hybrid models, when designed and implemented successfully, enable students to travel to campus for some activities, while using the network for others, taking advantage of the best of both environments.

**Increasingly, students want to use their own technology for learning.** As new technologies are developed at a more rapid and at a higher quality, there is a wide variety of different devices, gadgets, and tools from which to choose. Utilizing a specific device has become something very personal — an extension of someone’s personality and learning style — for example, the iPhone vs. the Android. There is comfort in giving a presentation or performing research with tools that are more familiar and productive at the individual level. And, with handheld technology becoming mass produced and more affordable, students are more likely to have access to more advanced equipment in their personal lives than at school.

**Massively open online courses are proliferating.** Led by the successful early experiments of world-class institutions (like MIT and Stanford), MOOCs have captured the imagination of senior administrators and trustees like few other educational innovations have. High profile offerings are being assembled under the banner of institutional efforts like edX, and large-scale collaborations like Coursera and the Code Academy. As the ideas evolve, MOOCs are increasingly seen as a very intriguing alternative to credit-based instruction. The prospect of a single course achieving enrollments in the tens of thousands is bringing serious conversations on topics like micro-credit to the highest levels of institutional leadership.

**Open is a key trend in future education and publication, specifically in terms of open content, open educational resources, massively open online courses, and open access.** As “open” continues its diffusion as a buzzword in education, it is increasingly important to understand the definition. Often mistakenly equated only with “free,” open education advocates are working towards a common vision that defines “open” as free, attributable, and without any barriers.

**Social media is changing the way people interact, present ideas and information, and judge the quality of content and contributions.** More than one billion people use Facebook regularly; other social media platforms extend those numbers to nearly one third of all people on the planet. Educators, students, alumni, and even the general public routinely use social media to share news about scientific and other developments. Likewise, scientists and researchers use social media to keep their communities informed of new developments. The fact that all of these various groups are using social media speaks to its effectiveness in engaging people. The impact of these changes in scholarly communication and on the credibility of information remains to be seen, but it is clear that social media has found significant traction in almost every education sector.

**There is an increasing interest in using data for personalizing the learning experience and for performance measures.** As learners participate in online activities, they leave a vast trace of data that can be mined for a range of purposes. In some instances, the data is used for intervention, enrichment, or extension of the learning experience. This can be made available to instructors and learners as dashboards so that student progress can be monitored. In other cases, the data is made available to appropriate audiences for measuring students’ academic performance. As this field matures, the hope is that this information will be used to continually improve learning outcomes.
Significant Challenges

Appropriate metrics of evaluation lag the emergence of new scholarly forms of authoring, publishing, and researching. Traditional approaches to scholarly evaluation such as citation-based metrics, for example, are often hard to apply to research that is disseminated or conducted via social media. New forms of peer review and approval, such as reader ratings, inclusion in and mention by influential blogs, tagging, incoming links, and re-tweeting, are arising from the natural actions of the global community of educators, with increasingly relevant and interesting results. These forms of scholarly corroboration are not yet well understood by mainstream faculty and academic decision makers, creating a gap between what is possible and what is acceptable.

Complexity is the new reality. One of the main challenges of implementing new pedagogies, learning models, and technologies in higher education is the realization of how inter-connected they all are. Games, for example, often overlap with natural user interfaces as well as social media with social networks, and learning analytics are increasingly associated with adaptive learning platforms. Even as we acknowledge that topics continuously converge, morph, and evolve, we need the proper language to accurately discuss and define them.

The demand for personalized learning is not adequately supported by current technology or practices. The increasing demand for education that is customized to each student's unique needs is driving the development of new technologies that provide more learner choice and control and allow for differentiated instruction. It has become clear that one-size-fits-all teaching methods are neither effective nor acceptable for today's diverse students. Technology can and should support individual choices about access to materials and expertise, amount and type of educational content, and methods of teaching.

Digital media literacy continues its rise in importance as a key skill in every discipline and profession. This challenge appears here because despite the widespread agreement on the importance of digital media literacy, training in the supporting skills and techniques is rare in teacher education and non-existent in the preparation of faculty. As lecturers and professors begin to realize that they are limiting their students by not helping them to develop and use digital media literacy skills across the curriculum, the lack of formal training is being offset through professional development or informal learning, but we are far from seeing digital media literacy as a norm. This challenge is exacerbated by the fact that digital literacy is less about tools and more about thinking, and thus skills and standards based on tools and platforms have proven to be somewhat ephemeral.

Dividing learning into fixed units such as credit hours limits innovation across the board. For a long time now, credit hours have been the primary way of marking the progress of students in earning their college degrees. This method implies that time is an accurate and effective measure for knowledge comprehension and skill. This industrial construct hinders the growth of more authentic learning approaches, where students and teachers might make use of more creative strategies not bound by such constraints.

Economic pressures and new models of education are bringing unprecedented competition to the traditional models of tertiary education. Across the board, institutions are looking for ways to control costs while still providing a high quality of service. Institutions are challenged by the need to support a steady — or growing — number of students with fewer resources and staff than before. As a result, creative institutions are developing new models to serve students. Simply capitalizing on new technology, however, is not enough; the new models must use these tools and services to engage students on a deeper level.
Institutional barriers present formidable challenges to moving forward in a constructive way with emerging technologies. Too often it is education’s own processes and practices that limit broader uptake of new technologies. Much resistance to change is simply comfort with the status quo, but in other cases, such as in promotion and tenure reviews, experimentation or innovative applications of technologies is often seen as outside the role of researcher or scientist.

MOOCs have put a spotlight on residential campus education and its unique value; the challenge is to identify and articulate that value in the context of MOOCs and financial issues. Much of the current discussion about MOOCs focuses on comparisons with learning at brick and mortar institutions. Early MOOC innovators and developers have expressed that they are not trying to replace face-to-face education, but apply lessons from distance learning that can also help improve on-campus learning. There is an important opportunity in the next several years to identify and articulate what successful physical campuses do best and what they can do that cannot be accomplished online. The challenge ahead is to identify the unique strengths and weakness of each for different types of teaching and learning activities, including a reexamination of the importance of the physical learning environment and how it can most effectively be integrated with virtual environments.

Massively open online courses are compelling, but universities must critically evaluate their use. MOOCs, by definition, aim to excel at providing scalable access to educational materials for the masses. However, they have been criticized for low completion rates and low engagement with the instructor, in addition to insufficient forms of assessment. There is an opportunity for educators to examine how universities can integrate MOOCs to support their existing courses and programs and create new ones, while carefully determining the audiences that are likely to benefit most. Other key components that will require much consideration are the process of identifying the optimal educational outcomes, and the type of accreditation that can be achieved.

Most academics are not using new and compelling technologies for learning and teaching, nor for organizing their own research. Many researchers have not had training in basic digitally supported teaching techniques, and most do not participate in the sorts of professional development opportunities that would provide them. This is due to several factors, including a lack of time, a lack of expectations that they should, and the lack of infrastructure to support the training. Academic research facilities rarely have the proper processes set up to accommodate this sort of professional development; many think a cultural shift will be required before we see widespread use of more innovative organizational technology. Many caution that as this unfolds, the focus should not be on the technologies themselves, but on the pedagogies that make them useful.