NMC | **Horizon Project**

Technology Outlook

Latin American Higher Education 2013-2018

An NMC Horizon Project Regional Analysis

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Is a collaboration between

The New Media Consortium

El Centro Superior para la Enseñanza Virtual (CSEV)

and

Virtual Educa

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Executive Summary

The *Technology Outlook > Latin American Higher Education 2013-2018: An NMC Horizon Project Regional Analysis* reflects a collaborative research effort between the New Media Consortium (NMC), Centro Superior para la Enseñanza Virtual (CSEV), and Virtual Educa to help inform education leaders about significant developments in technologies supporting teaching, learning, and creative inquiry at universities and colleges across Latin America.

All of the research underpinning the report makes use of the NMC's Delphi-based process for bringing groups of experts to a consensus viewpoint, in this case around the impact of emerging technologies on teaching, learning, or creative inquiry in Latin American higher education over the next five years. The same process underlies the well-known *NMC Horizon Report* series, which is the most visible product of an on-going research effort begun a decade ago to systematically identify and describe emerging technologies likely to have a large impact on education around the globe.

The *Technology Outlook > Latin American Higher Education 2013-2018* was produced to explore emerging technologies and forecast their potential impact expressly in a Latin American higher education context. In the effort that took place over May and June 2013, a carefully selected group of regional experts was asked to consider hundreds of relevant articles, news, blog posts, research, and project examples as part of the preparation that ultimately pinpointed the most notable emerging technology topics, trends, and challenges for higher education institutions in Latin America over the next five years.

Known as the 2013 Latin American Advisory Board, that group of experts consists of knowledgeable individuals, all highly regarded in their fields. Collectively, the advisory board represents a range of diverse perspectives across higher education in the Latin America sector. The project has been conducted under an open data philosophy, and all of the interim projects, secondary research, discussions, and ranking instrumentation can be viewed at ibero.wiki.nmc.org. The precise research methodology employed in producing the report is detailed in a special section that is located at the end of this report.

Table 1: Comparison of "Final 12" Topics Across Three NMC Horizon Research Projects

NMC Horizon Report 2013 Higher Education Edition	Technology Outlook Latin American Higher Education 2013-2018	Technology Outlook Iberoamerican Tertiary Education 2012-2017
Time-to-Adoption Horizon: One Year or Less		
Flipped Classroom Massive Open Online Courses Mobile Apps Tablet Computing	Collaborative Environments Online Learning Open Content Social Media	Cloud Computing Collaborative Environments Mobile Apps Open Content
Time-to-Adoption Horizon: Two to Three Years		
Augmented Reality Games and Gamification The Internet of Things Learning Analytics	Augmented Reality Learning Analytics Mobile Learning Personalized Learning	Game-Based Learning Geolocation Personal Learning Environments Tablet Computing
Time-to-Adoption Horizon: Four to Five Years		
3D Printing Flexible Displays Next-Generation Batteries Wearable Technology	3D Printing The Internet of Things Machine Learning Virtual and Remote Laboratories	Augmented Reality Learning Analytics Massive Open Online Courses Semantic Applications

The 12 "technologies to watch" presented in the body of this report reflect our experts' opinions as to which of the more than 40 technologies considered will be most important to higher education in Latin America over the five years following the publication of the report. As Table 1 above illustrates, the choices of our experts overlap in interesting ways with those who contributed to

the *NMC Horizon Report > 2013 Higher Education Edition,* which looked at technology uptake from a global perspective, and the *Technology Outlook > Iberoamerican Tertiary Education 2012-2017*, which was produced last year to explore the impact of technology across Iberoamerica (the regional term that encompasses Latin America, Spain, and Portugal).

All three of these projects' advisory boards — a group of 139 acknowledged experts — strongly agree that mobile learning, in some form, will tip into mainstream use within the next three years; although, the global advisory board sees this integration as more imminent at less than a year away. Whereas last year's Iberoamerican Advisory Board perceived learning analytics to be four to five years from widespread adoption, both the global and Latin American advisory boards cited the progress of the field over the past year and now see it positioned just two to three years away. It is worth noting that learning analytics received the most attention from the Latin American Advisory Board with 55 overall votes spread among 22 of the education experts — or more than 50% of the advisory board — solidifying it as a major area to watch across the region.

Table 2: Top-Ranked Trends Across Three NMC Horizon Research Projects

NMC Horizon Report 2013 Higher Education Edition	Technology Outlook Latin American Higher Education 2013-2018	Technology Outlook Iberoamerican Tertiary Education 2012-2017
Openness — concepts like open content, open data, and open resources, along with notions of transparency and easy access to data and information — is becoming a value.	Social media is changing the way people interact, present ideas and information, and judge the quality of the content and contributions.	People increasingly expect to be able to work, learn, and study whenever and wherever they want.
Massive open online courses are being widely explored as alternatives and supplements to traditional university courses.	Education paradigms are shifting to include online learning, hybrid learning, and collaborative models.	The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators in the processes of sense-making, coaching, and credentialing.
The workforce demands skills from college graduates that are more often acquired from informal learning experiences than in universities.	Massive open online courses are being widely explored as alternatives and supplements to traditional university courses.	Changes in university teaching have led many institutions to view the training of educators as a strategic element in assuring the quality of tuition.

There is also a consensus about augmented reality being positioned two to three years away from widespread adoption among the global and Latin American advisory boards. The Iberoamerican Advisory Board saw the technology as positioned on the far-term horizon just last year; however, the technology has become increasingy available and affordable, making it an appealing option for institutions and individual educators. Similarly, 3D printing appeared for the first time this year in the far-term horizon of this regional report, where it was also featured in the global edition. Rapid prototyping has applications across a wide range of disciplines, and 3D printers are much less expensive than they were a few years ago, thanks in part to the emergence of the MakerBot.

Both the Iberoamerican and Latin American Advisory Boards perceive open content as poised for imminent adoption, though the topic did not make the list for the global advisory board. There is a regional emphasis in Latin America on openness, whether in the form of open educational resources or open access, and several esteemed institutions and organizations are collaborating on open textbook initiatives and databases for the creation and dissemination of free resources.

Also noteworthy is the progression of online learning over the past year. While the Iberoamerican Advisory Board saw online learning in the form of massive open online courses (MOOCs) as four to five years in the distance for the region, both the global and Latin American Advisory Boards believe mainstream adoption will happen much sooner, at less than a year. Online platforms, such as unX, Acamica, and Veduca, have proliferated online courses and learning experiences in Latin America and beyond. Now more than ever, there is a clear and mounting emphasis on online learning and more pervasive access to learning opportunities across the region.

Several unique choices distinguished the viewpoints expressed by the 2013 Latin American Advisory Board from their counterparts. For the first time in the *NMC Horizon Report* series, machine learning is featured. The ability for technology to enable more authentic interactions between machines and individuals holds great promise for education, whether in the form of language software that is able to adapt to learners' needs based on the nuances of their voices or tools that can improvise plot developments for students enrolled in writing courses. Virtual and remote laboratories were also distinct to the 2013 Latin American report, lauded for taking the pressure off of Latin American institutions to purchase and maintain expensive, high quality lab equipment, and allowing learners to conduct experiments with greater flexibility.

The nuances of the technologies and their associated adoption horizons featured in this report are specific to Latin American higher education, even if there are commonalities with other reports. Likewise, the key trends (Table 2 and pages 17-18) and significant challenges (Table 3 and pages 19-20) selected by the 2013 Latin American Advisory Board distinctly reflect the current drivers and obstacles facing higher education in the region over the coming five years. In fact, there were no overlaps between the trends noted by the Latin American Advisory Board and the others.

Table 3: Top-Ranked Challenges Across Three NMC Horizon Research Projects

NMC Horizon Report 2013 Higher Education Edition	Technology Outlook Latin American Higher Education 2013-2018	Technology Outlook Iberoamerican Tertiary Education 2012-2017
Faculty training still does not acknowledge the fact that digital media literacy continues its rise in importance as a key skill in every discipline and profession.	There is a need for the creation of more flexible learning models.	Institutional structures must be changed to reflect the new models of the knowledge society.
The emergence of new scholarly forms of authoring, publishing, and researching outpace sufficient and scalable modes of assessment.	Most academics are not using new and compelling technologies for learning and teaching, nor for organizing their own research.	Technology must be efficiently and effectively integrated into teaching and research.
Too often it is education's own processes and practices that limit broader uptake of new technologies.	Appropriate metrics of evaluation lag the emergence of new scholarly forms of authoring, publishing, and researching.	Efforts to promote digital literacy are key to the development of the discipline and the profession.

For example, the advisory board agreed that the top trend is the rise of social media and how it is dramatically transforming the communication landscape. This emphasis on online networking and content sharing is fueling the rise of online learning and open content as educators are determined to develop systems that engage learners informally and make use of the resources already being shared via social media sites.

The growth of social media in Latin America is also being spurred by the second most significant trend cited by the advisory board — the emergence of new education paradigms to promote

hybrid and online learning. In Latin America, traditional higher education institutions are faciliating important discussions to determine ways to incorporate online and informal learning. This notion is evident in the third ranked trend, which explores MOOCs and the reactionary effort to find effective methods for online and face-to-face learning to supplement each other.

The experts spent a fair amount of time researching and discussing relevant trends and challenges in the context of teaching, learning, and creative inquiry in Latin American higher education. Horizon Project advisory boards in general have agreed that trends like these are clear drivers of technology adoption; the 2013 Latin American group especially saw such a linkage. At the same time, these panels of experts also agree that technology adoption is often hindered by both local and systemic challenges. Many challenges impacting technology uptake are grounded in everyday realities that often make it difficult to learn about, much less adopt, new tools and approaches.

While the 2013 Latin American and 2012 Iberoamerican Advisory Boards used varying wording, there are clear overlaps between two of the most significant challenges for both reports. For example, the most highly ranked challenge deals with a lack of flexibility in education models. Despite the fact that informal learning has proven benefits, current education systems do not reflect the way that people naturally learn. Many of the difficulties in integrating the information and communications technologies are related to current organizational models.

The second trend highlighted by the Latin American and Iberoamerican panels depicts the lack of emerging technology used by academics for teaching and research. Many educators simply have not received proper training, and when an institution mandates a new technology, there may not be clear understanding of how it ties in with pedagogies. Furthermore, research programs rarely include professional development in this area, leading many to believe that a cultural change is needed to usher in the widespread adoption of more innovative technologies.

Finally, the third challenge ranked by the Latin American advisory board corresponds with the second challenge cited by the global group. Both note that while there has been much progress made to innovate scholarly communication through blogging, social media, and other areas, there still are no concrete and effective forms of assessment for those models — likely because non-traditional forms of corroboration are not yet well understood by academic decision-makers.

These points and comparisons provide an important context for the main body of the report that follows this summary. There, 12 key technologies are profiled, each on a single page that describes and defines a technology ranked as very important for Latin American higher education institutions over the next year, two to three years, and four to five years. Each page opens with a carefully crafted definition of the highlighted technology, outlines its educational relevance, points to several real life examples of its current use, and ends with a short list of additional readings for those who wish to learn more. Following those discussions are sections that detail the advisory board's top ranked trends and challenges and articulate why they are seen as highly influential factors in the adoption of any of these technologies over the coming five years.

Those key sections, and this report in general, constitute a reference and straightforward technology-planning guide for educators, researchers, administrators, policymakers, and technologists. It is our hope that this research will help to inform the choices that institutions are making about technology to improve, support, or extend teaching, learning, and creative inquiry at Latin American institutions. Educators and administrators worldwide look to the NMC Horizon Project and both its global and regional reports as key strategic technology planning references, and it is for that purpose that the *Technology Outlook > Latin American Higher Education 2013-2018* is presented.

Collaborative Environments

Collaborative environments are online spaces — often cloud-based — where the focus is on making it easy to collaborate and work in groups, no matter where the participants may be. As the typical educator's network of contacts has grown to include colleagues who might live and work across the country, or indeed anywhere on the globe, it has become common for people who are not physically located near each other to nonetheless collaborate on projects. Joint classroom-based projects with students at other schools or in other countries are more and more common strategies used to expose learners to a variety of perspectives. The essential attribute of the technologies in this set is that they make it easy for people to share interests and ideas, to easily monitor their collective progress, and to see how ideas have evolved throughout the process. These tools are compelling and widely adopted because they are not only easy to use, but they are also either very low cost or free, and often accessible with a simple web browser.

Relevance for Teaching, Learning, or Creative Inquiry

- A class or project group can assemble a collaborative workspace very quickly using widgets that pull information from a range of sources.
- Collaborative environments are an efficient way for students to work together, whether the groups are composed of students in the same physical class or not.
- Large-scale collaborative environments can facilitate an almost spontaneous development of communities of people who share similar interests.

Collaborative Environments in Practice

- Institutions across Latin America are using ePals Global Community to connect with students all over the world for language and cultural exchanges through email, video chat, and collaborative workspaces: go.nmc.org/epals.
- Moodle recently partnered with InterClase, an educational technology solution provider based in Bolivia, to support the use of online collaborative tools throughout the country: go.nmc.org/partn.
- Universidad Austral Law School and School of Education in Buenos Aires, Argentina have been using Google Apps for Education to build course portals and collaborative learning environments: go.nmc.org/bass.

For Further Reading

Collaborative Learning in Virtual Environments and its Social Constructivist Base as a Way for Meaningful Learning
go.nmc.org/collab
> (Edith Inés Ruiz Aguirre, Nadia Livier Martínez de la Cruz, Rosa María Galindo González. *Revista Apertura*. 2012.) Researchers from the University of Guadalajara describe the formation of learning communities around the Web 2.0 and what sorts of tools are being used to facilitate online collaboration. They discuss wikis, discussion forums, blogs, email and chats among the methods that support social constructivist virtual pedagogies.

The Global Search for Education: Social Learning
go.nmc.org/edmo
> (C.M. Rubin, *The Huffington Post*, 21 February 2013.) With over 17 million users on its free collaborative learning platform, Edmodo has a global reach that brought together more than 12,000 teachers from 120 countries at the company's last conference. Advocates of the software believe that Edmodo has the potential to create the largest online network of teachers and classrooms in the world.

Time-to-Adoption: One Year or Less

Online Learning

Online learning is not new; the category encompasses any learning that takes place through web-based platforms, whether formal or informal. The learning can be structured like as in traditional courses or entirely self-paced. What has made the topic new is the recent and unprecedented focus on providing learning via the Internet that has been stimulated by the tremendous interest in massive open online courses (MOOCs). What is new in this space is that online learning has "come of age;" the design of online learning is (more and more) specifically intended to encompass the latest research, the most promising developments, and new emerging business models in the online learning environment. At many institutions, online learning is an area newly ripe for experimentation — some would argue it is undergoing a sea change, with every dimension of the process open for reconceptualization. On campuses around the globe, virtually every aspect of how students connect with institutions and each other to learn online is being reworked, rethought, and redone — but it will be some time yet before ideas coalesce enough to be validated by research and implemented broadly.

Relevance for Teaching, Learning, or Creative Inquiry

- As new pedagogies emphasize personalized learning, there is a growing demand for learner-centered online opportunities. Online learning environments, when designed effectively, have the potential to scale globally.
- Online learning environments can make creative use of several educational technologies and emerging instructional approaches, including blended learning, video lectures, and badges.
- When placed online, a diverse set of learning resources is easily accessible to students and can support self-directed learning.

Online Learning in Practice

- Acamica is a platform used by Latin American learners to access interactive courses from experts in different areas. As students progress, they build online knowledge profiles to share with prospective employers or institutions: go.nmc.org/aca.
- The online learning platform Veduca provides Brazilian users with 5,000 online classes, licensed from some of the world's top universities, such as MIT, Harvard, Yale, and Princeton, and translates them into Portuguese: go.nmc.org/ved.
- Through the open source platform unX, Iberoamerican universities can offer MOOCs for online learning and vocational training. The model includes interactive features, along with a digital badging system: go.nmc.org/unXIA.

For Further Reading

The Single Most Important Experiment in Higher Education
go.nmc.org/single
> (Jordan Weissmann, *The Atlantic*, 18 July 2012.) This article discusses Coursera's new partnerships with several universities. One institution, the University of Washington, is giving credit for its Coursera courses. The funding from these new alliances will allow the company to blossom as a market for learning.

With New Exchange, TareasPlus Takes on Khan Academy in Latin America and Beyond
go.nmc.org/tareas
> (Ki Mae Heussner, *Gigaom*, 29 April 2013.) TareasPlus, a Colombian-based start-up, has dubbed itself the Khan Academy of Latin America. This article explains how both companies are competing for the attention of Spanish-speaking students.

Time-to-Adoption: One Year or Less

Open Content

The movement toward open content reflects a growing shift in the way scholars in many parts of the world are conceptualizing education to a view that is more about the process of learning than the information conveyed. Information is everywhere; the challenge is to make effective use of it. Open content uses Creative Commons and other forms of alternative licensing to encourage not only the sharing of information, but the sharing of pedagogies and experiences as well. Part of the appeal of open content is that it is a response to both the rising costs of traditionally published resources and the lack of educational resources in some regions. As this open, customizable content — and insights about how to teach and learn with it — is increasingly made available for free over the Internet, people are learning not only the material, but also the skills related to finding, evaluating, interpreting, and repurposing the resources. Recent data from Edcetera indicate that open educational resources make up three quarters of the content in most MOOCs; paid content, such as required textbooks, is less than 10%. These data reflect a notable transformation in the culture surrounding open content that will continue to impact how we think about content production, sharing, and learning.

Relevance for Teaching, Learning, or Creative Inquiry

- Open, sharable materials reduce teacher workloads; open educational resources do not need to be created from scratch.
- Most of the world's top institutions are providers of open content and have created a wealth of materials now available on demand to anyone.
- The use of open content promotes a set of skills that are critical in maintaining currency in any area of study — the ability to find, evaluate, and put new information to use.

Open Content in Practice

- The LATIn Open Textbooks initiative develops and disseminates textbooks by and for Latin America, with the goal of launching a collaborative platform for developing texts with a Creative Commons license: go.nmc.org/latin.
- Michigan State University created the Latin America Open Resource Collection, providing users with open resources that depict challenges facing the region: go.nmc.org/latlearn.
- The Spanish P2P Foundation offers a collaborative online space for sharing and mapping open projects that impact education, business, and government: go.nmc.org/p2p.

For Further Reading

Conditions Required to Implement OER Practices in the Higher Education of Latin America
go.nmc.org/OCC
> (Cristobal Cobo, *Open Courseware Consortium*, April 2012) The Open Courseware Consortium features a presentation about the active research that explores how to stimulate open educational resources (OER) and build awareness in Latin America.

Embracing openness: The challenges of OER in Latin American education
go.nmc.org/OERembrace
> (Nadia Paola Mireles Torres, *Open Praxis*, January-March 2013) This paper analyzes the challenges facing OER in Latin American countries.

Open Educational Resources in Mexico and Latin America
go.nmc.org/OERmexla
> (Vladimir Burgos, *Open Education Week*, 27 February 2013) A video discusses different open educational resources for Latin America, led by Universidad Virtual Tec de Monterrey.

Time-to-Adoption: One Year or Less

Social Media

Today's web users are prolific creators of content, and they upload photographs, audio, and video to cloud-based social media sites such as Facebook, Pinterest, Twitter, YouTube, Flickr, and many others by the billions. While the initial emphasis of social media was placed on producing and uploading media to these popular sharing sites, as the notion of social media has evolved it has ultimately become more about the conversations started and relationships formed via this media. When users log in to Facebook and Twitter, two of the sites that have the most subscribers and daily traffic, they are there to see what their family, friends, and favorite brands and organizations are doing and who is talking about what. For educational institutions, social media enables two-way dialogues between students, prospective students, educators, and the institution that are less formal than with other media. New tools, such as Facebook's social search engine, promise to mine these interactions using a concept known as the social graph. A person's social graph represents the sum of all of a person's online social connections (who he or she is friends with, who likes the things she or her friends are interested in, who among those connections is where, etc.) and provides a means to search and navigate those connections. Social graphs can be visualized in a variety of interesting ways, but far more interesting is the information embedded within the social graph and what it can tell us.

Relevance for Teaching, Learning, or Creative Inquiry

- Engagement in social media, either as producers of content, or consumers, or aggregators of user-generated content, will allow universities to more deeply connect with audiences.
- Social media outlets allow university staff and students to create powerful personal learning networks to direct and focus their own learning.
- Video platforms including YouTube and Vimeo enable educators to upload and share recorded lectures and other instructional videos that students can watch anywhere.

Social Media in Practice

- As part of their professional development, faculty at Northwest Mississippi Community College received training for facilitating aspects of their courses using various social media tools, including Facebook, Twitter, Instagram, Storify, and YouTube: go.nmc.org/nwsm.
- Faculty at Texas State University are encouraging students to use Facebook and Twitter both inside and outside the classroom to engage in discussions: go.nmc.org/txstate.
- Universidad del Zulia in Venezuela developed a strategy that uses Twitter and Facebook to recruit students and keep them informed of on-campus events: go.nmc.org/luz.

For Further Reading

The Integration of Social Networks and Virtual Learning Environments
go.nmc.org/loja
> (Juan Carlos Torres-Diaz, et al, *Revista de Educación a Distancia*, 1 January 2013.) Researchers from Universidad Tecnica Particular de Loja in Ecuador reveal findings on a new learning model that they developed to integrate social networks into Moodle.

Social Networks and University Spaces. Knowledge and Open Innovation in the Ibero-American Knowledge Space (PDF)
go.nmc.org/socnet
> (Daniel Domínguez Figaredo and José Francisco Álvarez Álvarez, UNED, January 2012.) This paper written by UNED faculty explores the role of information technology-based social networks in sparking faculty and community participation.

Time-to-Adoption: Two to Three Years

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, 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

- The Health CARE project by the City University of London is integrating augmented reality to enhance the curriculum in the School of Health Sciences: go.nmc.org/cityu.
- Researchers at the University of Cambridge are using augmented reality to help children diagnosed with autism engage in more visual and imaginative play: go.nmc.org/makeb.
- A team of students at a Canadian university used the video and audio layering capability of the AR tool Aurasma to recreate the sights and sounds of a historical hockey stadium in Toronto: go.nmc.org/maple.
- The University of Michigan is making construction sites safer via augmented reality. By visualizing a work site prior to its establishment, engineers can plan in a virtual environment: go.nmc.org/impcon.

For Further Reading

Augmented Reality in Education: Teaching Tool or Passing Trend?
go.nmc.org/artrend
> (Judy Bloxham, *The Guardian*, 11 February 2013) Augmented reality is maturing and becoming more useful in the field of education. The author describes several higher education examples, including the use of AR for accessing rare books and manuscripts.

Playing with Augmented Reality
go.nmc.org/ardef
> (Lauren Biron, *Defense News*, 22 May 2013) The U.S. Army and the University of Central Florida have teamed up to help reinforce procedures and concepts for combat medics. By scanning special playing cards enhanced by augmented reality markers, medics are able to see videos and animations that demonstrate procedures including hemorrhage control, chest compressions, and proper tourniquet application.

Time-to-Adoption: Two to Three Years

Learning Analytics

Learning analytics is education's approach to "big data," a science that was originally leveraged by businesses to analyze commercial activities, identify spending trends, and predict consumer behavior. The rise of the Internet drove research into big data and metrics as well as the proliferation of web tracking tools, enabling companies to build vast reserves of information they could study and leverage in their marketing campaigns. Education is embarking on a similar pursuit into data science with the aim of improving student retention and providing a high quality, personalized experience for learners. Learning analytics research uses data analysis to inform decisions made on every tier of the educational system. Whereas analysts in business use consumer data to target potential customers and personalize advertising, learning analytics leverages student data to build better pedagogies, target at-risk student populations, and assess whether programs designed to improve retention have been effective and should be sustained — outcomes for legislators and administrators that have profound impact. For educators and researchers, learning analytics has been crucial to gaining insights about student interaction with online texts and courseware. Students are beginning to experience the benefits of learning analytics as they engage with mobile and online platforms that track data to create responsive, personalized learning experiences.

Relevance for Teaching, Learning, 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.
- The promise of learning analytics is that it will enable teachers to more precisely identify students' learning needs and tailor instruction appropriately.

Learning Analytics in Practice

- A Jesuit education center in El Salvador worked with a technology solution provider to develop a customized evaluation and reporting system for students with autism: go.nmc.org/jesuita.
- Researchers at the University of Sao Paulo developed and implemented an intelligent tutoring system on Moodle for an online financial math course: go.nmc.org/intell.
- Supported by the Bill and Melinda Gates Foundation, PAR is a collaborative data-mining project between 16 universities: go.nmc.org/parf.

For Further Reading

Big Data for Education: Data Mining, Data Analytics, and Web Dashboards
go.nmc.org/analy
> (Darrell M. West, The Brookings Institute, 4 September 2012.) The Founding Director of the Center for Technology Innovation describes what learning will look like when digital resources and data are leveraged to provide real-time feedback for students.

Enhancing Teaching and Learning Through Educational Data Mining and Learning Analytics
go.nmc.org/enh
> (Marie Bienkowski et al., U.S. Department of Education, October 2012.) Data analytics mining is established in the commercial world and similar techniques can be applied in education.

Learning and Knowledge Analytics (PDF)
go.nmc.org/laknow
> (George Siemens and Dragan Gasevic, *Journal of Educational Technology & Society*, Vol. 15, No. 3, July 2012.) In a special edition of the Journal, seminal learning analytics experts George Siemens and Dragan Gasevic discuss the maturation of learning analytics and its impact on education.

Time-to-Adoption: Two to Three Years

Mobile Learning

People increasingly expect to be connected to the Internet and the rich tapestry of knowledge it contains wherever they go. Mobile devices, including smartphones and tablets, enable users to do just that via cellular networks and wireless power. At the end of 2012, the mobile market consisted of over 6.5 billion subscribers, with a majority living in developing countries. The growing number of users, coupled with the unprecedented evolution of these devices, has opened the door to myriad uses for education. Learning institutions all over the world are exploring ways to make their websites, educational materials, resources, and opportunities all available online and optimized for mobile devices. The most compelling facet of mobile learning right now is mobile apps. Smartphones and tablets have redefined what we mean by mobile computing, and in the past four to five years, apps have become a hotbed of development, resulting in a plethora of learning and productivity apps. These tools, ranging from annotation and mind-mapping apps to apps that allow users to explore outer space or get an in-depth look at complex chemicals, enable users to learn and experience new concepts wherever they are, often across multiple devices.

Relevance for Teaching, Learning, or Creative Inquiry

- As a one-to-one solution, mobile learning presents an economic, flexible alternative to laptops and desktops due to the devices' lower cost, greater portability, and access to apps.
- Mobile apps with built-in social features enable learners to share their questions or findings with each other in real-time. For example, productivity apps such as Evernote and Edmodo make it possible to exchange notes, assignments, videos, and more.
- Students can leverage the cameras, microphones, and other tools inherent in mobiles to do field work or create rich media. This is especially convenient for work done outside of the classroom as students can record interviews, collect data for experiments, and more.

Mobile Learning in Practice

- Fundación Chile created a free online college preparation program that is accessible via mobile devices. It prepares young people to take the obligatory university admission test (Prueba de Selección Universitaria): go.nmc.org/psu.
- A physics professor at the Instituto Tecnológico y de Estudios Superiores de Monterrey developed Mobile Intelligent Laboratory (M-iLab), a mobile application that allows one's device to become part of a physics experiment: go.nmc.org/mil.
- University of Wollongong students who are studying primary school education created animations for science concepts using smartphone cameras: go.nmc.org/smation.

For Further Reading

Colleges Go Mobile on Multiple Fronts
go.nmc.org/gomo

> (Steve Zurier, *EdTech Magazine*, 10 June 2013.) Seton Hill University and Ohio State University are leaders in mobile learning, recognizing that students should be able to access information wherever they are. This article outlines several of the universities' mobile initiatives, from lecture capture to e-textbooks.

Tablets and Education: A Revolution Still Silent in Latin America
go.nmc.org/tabrev

> (Clarisa Herrera, *PulsoSocial*, 27 March 2013.) In 2012, the number of tablets sold increased by 154% in Latin America, and is expected to continue rising at a steady pace. Despite the surge of consumer demand for mobile devices, some educators question why Latin American institutions are slower to adopt tablets into curriculum.

Time-to-Adoption: Two to Three Years

Personalized Learning

Personalized learning has been evolving for some time, and includes a wide variety of approaches to support self-directed and group-based learning that can be designed around each user's goals, including personalized learning environments and networks, adaptive learning tools, and more. Using a growing set of free and simple resources, such as a collection of apps on a tablet, it is already quite easy to support one's ongoing social and professional learning and other activities with a collection of resources and tools that people always have on hand. There are two paths of development for personalized learning: the first is organized by and for the learner, which includes these resources (e.g., apps, social media, etc.); and institutional goals and interests are driving the other in the form of adaptive learning. In this view, which envisions tools and data streams that are still some time away from being seen in educational institutions, adaptive learning is enabled by intervention-focused machine intelligence that interprets data about how a student is learning and responds by changing the learning environment based on their needs. It is likely that adaptive learning will first appear in large online environments from which big data can be extracted and patterns identified, based on the thousands of students in attendance.

Relevance for Teaching, Learning, or Creative Inquiry

- Adaptive learning tools are envisioned as providing students and educators with real-time information about how lessons are progressing, with adjustments made in real time to better cater to the immediate learning needs.

- Inherently sensitive to learning styles, personalized learning caters, for instance, to visual learners by providing different forms of materials than for textual or auditory learners.

- Personalized learning is seen as a key and necessary component of the next generation of higher education institutions and learning.

Personalized Learning in Practice

- Northern Arizona University launched a personalized learning program that leverages more than 90 online courses to offer degree plans that are more customizable. Each degree program has a clear set of modules and learning outcomes defined by faculty, but the path from start to finish is completely flexible: go.nmc.org/nau.

- Responsive Open Learning Environments (ROLE) is a collaborative initiative between 16 internationally renowned research groups from six European countries and China, centered around self-regulated learning. The goal is to foster learners who are able to plan their own learning processes: go.nmc.org/rol.

For Further Reading

Personal Learning Environments: Keys to the Educational Ecosystem Network
go.nmc.org/edeco
> (Linda Castañed and Jordi Adell, *Alcoy: Marfil*, 2013.) This free, Spanish downloadable e-book delves into the concept of personalized learning, explaining how the massive technical and cultural change that has taken place in the past 20 years has given learners access to more resources and the ability to customize their own learning paths.

The Year of Personalized Learning
go.nmc.org/per
> (Chistopher Etesse, *Flatworld Knowledge*, 7 January 2013.) Research indicates that one of the top reasons students drop out of a university is because they choose the wrong major. The author describes how some institutions are combating this issue by creating flexible learning tools, such as apps, and changing university-funding models to support the personalization of educational experiences.

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 3D modeling software, computer-aided design (CAD) tools, computer aided tomography (CAT), and X-ray crystallography. A 3D printer builds a tangible model or prototype from the electronic file, one layer at a time, through an extrusion-like process using plastics and other flexible materials, or an inkjet-like process to spray a bonding agent onto a very thin layer of fixable powder. The deposits created by the machine can be applied very accurately to build an object from the bottom up, layer by layer, with resolutions that, even in the least expensive machines, are more than sufficient to express a large amount of detail. The process even accommodates moving parts within the object. Using different materials and bonding agents, color can be applied, and 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) that can be conveyed in three dimensions.

Relevance for Teaching, Learning, or Creative Inquiry

- 3D printing allows for more authentic exploration of objects that may not be readily available to schools, including animal anatomies and toxic materials.

- The exploration of 3D printing, from design to production, as well as demonstrations and participatory access, can open up new possibilities for learning activities.

- Typically, 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

- At Konrad Lorenz University in Colombia, engineering students use 3D printers to design, prototype, and test utilitarian products: go.nmc.org/konrad.

- The Fundacio CIM Polytechnic University of Cataluna, in partnership with the company RepRap, has developed a 3D printer for home use for 900 euros: go.nmc.org/home3d.

- In Peru, Universidad de Piura students use a MakerBot Replicator 2 to create automobile prototypes: go.nmc.org/ingen.

For Further Reading

4D Printing: The New Frontier
go.nmc.org/4dp
> (Oliver Marks, *ZDNet*, 14 March 2013.) Advances in nano biotechnology are leading to new materials that can be programmed to change their form over time. This could lead to innovations including objects that assemble and disassemble depending on temperature.

Impact of 3D Printing Libraries
go.nmc.org/3dlib
> (Beatriz Ovejero, Biblogtecarios, 6 June 2013.) The author of this Spanish post describes how 3D printing can help expand the usefulness of academic and scientific libraries by enabling visitors to go a step further in researching and learning.

Ten Reasons to Integrate 3D Printers in Education
go.nmc.org/razones
> (Joan Matias Longo, *Sobre Tizo*, 27 February 2013.) The CEO of the well-known Argentine 3D printing company Kikai Labs describes, in Spanish, the top ten uses of the technology in education, including the facilitation of collaborative work.

Time-to-Adoption: Four to Five Years

The Internet of Things

The Internet of Things conveys information communicated by network aware objects that connect the physical world with the world of information through the web. It does so through TCP/IP, the set of standards that enables network connections and specifies how information finds its way to and from the myriad of connections it contains. TCP/IP was formulated in the 1970s by Vinton Cerf and Robert E. Kahn. The advent of TCP/IP v6, launched in 2006, added enormous new addressing capabilities to the Internet, and enabled objects and the information they might carry in attached sensors or devices to be addressable and searchable across the web. This expanded address space is particularly useful for tracking objects that monitor sensitive equipment or materials, point-of-sale purchases, passport tracking, inventory management, identification, and similar applications. Embedded chips, sensors, or tiny processors attached to an object allow helpful information about the object, such as cost, age, temperature, colour, pressure, or humidity to be transmitted over the Internet. This simple connection allows remote management, status monitoring, tracking, and even alerts if the objects they are attached to are in danger of being damaged or spoiled. Traditional web tools allow objects to be annotated with descriptions, instructions, warranties, tutorials, photographs, connections to other objects, and any other kind of contextual information. The Internet of Things makes access to these data as easy as it is to use the web.

Relevance for Teaching, Learning, 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 every artifact in their collections of specimens from anywhere to anyone with an Internet connection.

The Internet of Things in Practice

- Founded in Bogotá, Colombia, Ubidots is a platform for makers and developers to build sensor networks and collect data, and its technology is currently serving three of the top 25 hospitals in Latin America: go.nmc.org/ubidot.

- The Mexican government is investing $10,000 million to build the infrastructure that will make Guadalajara a smart city as part of its Creative Digital City initiative: go.nmc.org/mex

- Students at the Universidad Autónomoa Occidente in Colombia completed a weeklong "Boot Camp," applying Internet of Things concepts via Arduino devices: go.nmc.org/boot.

For Further Reading

Internet of Things
go.nmc.org/cosa
> (Andreu Belsunces Gonçalvez, *Cromo*, 1 June 2013.) Wireless networks now allow objects in the environment to communicate with each other. The author describes the current state of the Internet of Things and what society can expect from it in the future.

IPv6: The Motor of the Web of Things
go.nmc.org/think
> (Cristina Peña and Carlos Ralli, *Think Big Blog*, 4 April 2013.) The rapid acceleration of IPv6 is creating a new paradigm where all objects will have IP address, exist on the Internet, and offer services to users. This article includes diagrams and technical descriptions.

Time-to-Adoption: Four to Five Years

Machine Learning

Machine learning refers to computers that are able to act and react without being explicitly programmed to do so. Computer scientists and engineers are developing systems that not only intake, retrieve, and interpret data, but also learn from it. To do this, the machine must make a generalization, using its algorithm to perform accurately on new examples after being trained on a different learning data set — much like a human learns from experiences and uses that knowledge to respond appropriately in a different encounter. In this sense, machine learning is widely considered by many researchers and thought leaders to reflect an emerging approach towards human-like artificial intelligence. Practical speech recognition, semantic applications, and even self-driving cars all leverage machine learning. A recent incarnation of machine learning is software called Xapagy, which improvises dialogue and plot moves in stories fed to it by users. The potential of machine learning for education is vast, facilitating altogether smarter technology that has the accuracy of a computer and the adaptability of the most intelligent human beings.

Relevance for Teaching, Learning, or Creative Inquiry

- Language or writing software that employs machine learning to detect patterns in writing, speech, and other actions could better adapt to students' learning styles and needs.

- Machine learning models can potentially sort through learner-contributed observations about the world around them and create visualizations that identify crucial patterns.

- Ultimately, machine learning promises to enable educators and learners to communicate more authentically with their devices — even in improvised ways, just as a colleague or friend would; it is foreseeable that students could collaborate with machines on projects.

Machine Learning in Practice

- Etiometry is building a clinical-decision support system to interpret large volumes of real-time patient data and provide doctors with actionable analytics: go.nmc.org/icu.

- Led by an astronomy professor at the University of California, Berkeley, a team developed a machine learning telescope model that can automatically detect significant changes pointing to supernova occurrences: go.nmc.org/wis.

- PaperRater's free software offers grammar checking, style and word choice analysis, and more by combining natural language processing, artificial intelligence, machine learning, data mining, and advanced pattern matching: go.nmc.org/pap.

For Further Reading

Computers to See, Hear, Smell in Five Years
go.nmc.org/ibmpre
> (*Fox News*, 17 December 2012.) IBM predicts an era of cognitive systems, in which machines will learn, adapt, sense, and experience the world. Computers would have a sense of touch and understanding of sounds, parsing emotion, sentiment, and desire in changes of pitch and frequency.

The Man Behind the Google Brain: Andrew Ng and the Quest for the New AI
go.nmc.org/goobra
> (Daniela Hernandez, *Wired*, 7 May 2013.) The Google Brain movement, led by Stanford professor Andrew Ng, seeks to meld computer science with neuroscience in a new field of computer science known as deep learning, so that machine learning will mimic the way human brains learn.

Time-to-Adoption: Four to Five Years

Virtual and Remote Laboratories

Virtual and remote laboratories reflect a movement among education institutions to make the equipment and elements of a physical science laboratory more easily available to learners from any location, via the web. Virtual laboratories are web applications that emulate the operation of real laboratories and enable students to practice in a "safe" environment before using real, physical components. Students can typically access virtual labs 24/7, from wherever they are, and run the same experiments over and over again. Some emerging virtual lab platforms also incorporate reporting templates that populate with the results of the experiments so that students and teachers can easily review the outcomes. Remote laboratories, on the other hand, provide a virtual interface to a real, physical laboratory. Institutions that do not have access to high-caliber lab equipment can run experiments and perform lab work online, accessing the tools from a central location. Users are able to manipulate the equipment and watch the activities unfold via a webcam on a computer or mobile device. This provides students with a realistic view of system behavior and allows them access to professional laboratory tools from anywhere, whenever they need. Additionally, remote labs alleviate some financial burden for institutions as they can forgo purchasing specific equipment and use the remote tools that are at their disposal.

Relevance for Teaching, Learning, or Creative Inquiry

- Because virtual laboratories do not involve real equipment or chemicals, students can feel more comfortable making mistakes and running experiments as often as they like.
- Educators can play back videos of the experiments students have run online, pinpoint areas of improvement, and acknowledge students who have excelled.
- Virtual and remote laboratories increase access to science tools, allowing learners from all over the world to use them via wireless or cellular networks; laboratory work is no longer limited to spaces on physical campuses.

Virtual and Remote Laboratories in Practice

- In Spain, the University of Deusto's Web-Lab Deusto offers several remote laboratories to students through the Internet and a set of APIs for developing new labs: go.nmc.org/deu.
- Northwestern University's remote lab, iLab Central, gives teachers and learners access to high-caliber science equipment housed at the University of Queensland: go.nmc.org/ilab.
- The Virtual Microscope is a project by the University of Illinois at Urbana-Champaign that provides simulated scientific instruments for learners worldwide: go.nmc.org/virtmic.

For Further Reading

Are Virtual Labs As Good as Hands-On?
go.nmc.org/lab
> (Ruth Colvin Clark, *ASTD*, 22 June 2012.) This article describes an experiment that proved virtual labs can be as effective as hands-on labs to promote conceptual learning.

Flipping Lab Science with Remote Labs
go.nmc.org/flipsci
> (Jim Vanides, *Guide2DigitalLearning*, accessed 19 March 2013.) The author explores the role of remote science labs in the flipped classroom model.

Top Ten Trends Impacting Technology Decisions

The technologies featured in the NMC Horizon Project are embedded within a contemporary context that reflects the realities of the time, both in the sphere of education and in the world at large. These trends are surfaced through an extensive review of current articles, interviews, papers, and new research. Once identified, the list of trends is ranked according to how significant of an impact they are likely to have on education in the next five years. The following ten trends have been identified as key drivers of technology adoptions in higher education institutions across Latin America for the period of 2013 through 2018; they are listed here in the order they were ranked by the advisory board.

1) Social media is changing the way people interact, present ideas and information, and judge the quality of the content and contributions. More than one billion people use Facebook regularly; other social media platforms extend those numbers to nearly one in six people on the planet. Educators, students, alumni, and even the general public routinely use social media to share news about scientific and other developments. 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.

2) Education paradigms are shifting to include online learning, hybrid learning, and collaborative 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. Online learning environments can 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.

3) Massive open online courses are being widely explored as alternatives and supplements to traditional university courses. 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, the Code Academy, and in Australia, Open2Study. As the ideas evolve, MOOCs are seen more and more 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.

4) Increasingly, students want to use their own technology for learning. As new technologies are developed at a more rapid pace 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 advanced equipment in their personal lives than at school.

5) Openness — concepts like open content, open data, and open resources, along with notions of transparency and easy access to data and information — is becoming a value. As authoritative sources lose their importance, there is need for more curation and other forms of validation to generate meaning in information and media. "Open" has become a term often

applied in very different contexts. Open education advocates are working towards a common vision that defines "open" broadly — not just free in economic terms, but educational materials that are freely copiable, freely remixable, and free of barriers to access, sharing, and educational use.

6) As the abundance of resources and relationships made easily accessible via the Internet grows, we are ever more challenged to revisit our roles as educators. Institutions must consider the unique value that schools add to a world in which information is everywhere, and generally free. 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. Brick-and-mortar universities have always been seen as critical paths to educational credentialing, but challenges from competing sources are redefining what these paths can look like.

7) The technologies we use are more and more cloud-based, and our notions of IT support are decentralized. The continuing acceptance and adoption of cloud-based applications and services is changing not only the ways we configure and use software and file storage, but also how we conceptualize those functions. It does not matter where our work is stored; what matters is that our information is accessible no matter where we are or what device we choose to use. Globally, in huge numbers, we are growing accustomed to a model of browser-based software that is device independent. While some challenges still remain, specifically with notions of privacy and sovereignty, the promise of significant cost savings is a driver in the search for solutions.

8) People expect to be able to work, learn, and study whenever and wherever they want. Life in a busy world where learners must balance demands from home, work, school, and family poses a host of logistical challenges with which today's ever more mobile students must cope. Work and learning are often two sides of the same coin, and people want easy and timely access not only to the information on the network, but also to tools, resources, and up-to-the-moment analysis and commentary. These needs, as well as the increasingly essential access to social media and networks, have risen to the level of expectations. The opportunities for informal learning in the modern world are abundant and diverse, and greatly expand on earlier notions like "just-in-time" or "found" learning.

9) The world of work is increasingly collaborative, driving changes in the way student projects are structured. As more and more employers are valuing collaboration as a critical skill, silos both in the workplace and at school are being abandoned in favor of collective intelligence. To facilitate more teamwork and group communication, projects rely on tools like wikis, Google Doc, Skype, and online forums. Projects are increasingly evaluated by educators not just on the overall outcome, but also on the success of the group dynamic. In many cases, the online collaboration tool itself is an equally important outcome as it stores — and even immortalizes— the process and multiple perspectives that led to the end results.

10) There is a growing interest in using new sources of data for personalizing the learning experience and for performance measurement. As learners participate in online activities, they leave a clear trail of analytics data that can be mined for insights. Learning analytics experiments and demonstration projects are currently examining ways to use data for enrichment. Dashboards filter this information so that student progress can be monitored in real time. As the field of learning analytics matures, the hope is that this information will enable continual improvement of learning outcomes.

Top Ten Most Significant Challenges

Along with the trends discussed in the preceding section, the advisory board noted a number of important challenges faced in higher education institutions across Latin America. Like the trends, the challenges described below were drawn from a careful analysis of current events, papers, articles, and similar sources, as well as from the personal experience of the advisory board members in their roles as leaders in education and technology. The ten challenges ranked as most significant in terms of their impact on teaching, learning, or creative inquiry in Latin American higher education in the coming five years are listed here, in the order of importance assigned them by the advisory board.

1) There is a need for the creation of more flexible learning models. 21st Century learning calls for more blended learning models, including online, face-to-face, and ICT-mediated learning — and each form requires a lot of thought in terms of integrating them all together. There is already research supporting the fact that students garner a lot of new knowledge informally, but there is a lack of concrete educational models in Latin America that support resource sharing and social networking for this style of learning, in addition to better incorporating it at higher education institutions.

2) 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 and a lack of expectations that they should. Many think a cultural shift will be required before we see widespread use of more innovative organizational technology. Some educators are apprehensive about working with new technologies, as they fear the tools and devices have become more of a focus than the learning. Adoption of progressive pedagogies, however, is often enabled through the exploration of emerging technologies, and thus a change in attitude among academics is imperative.

3) 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 more and more 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.

4) Education professionals must strengthen training in the educational use of ICT and stimulate collective innovation. Simply put, there is not enough integration of ICT-training in Latin American higher education curriculum. This may be the product of an overall lack of professional development for faculty in this area. As a result, there is a push from education thought leaders to create programs that drive ICT education and collaboration between students and faculty across multiple institutions to spurn more university-created technologies and initiatives.

5) Faculty training still does not acknowledge the fact that digital media literacy continues its rise in importance as a key skill in every discipline and profession. 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.

6) Higher education institutions must strengthen infrastructure through improving internet coverage, provide free access in public spaces, and provide free or low-cost equipment for teaching and learning. In the trends section it was noted that students expect to be able to work, learn, and play from wherever they are, and on whichever devices they prefer. However, higher education institutions in Latin America are still not yet equipped with sufficient infrastructure to promote ubiquitous learning. While many students are bringing their laptops or tablets to campus with them, not everyone can afford the same caliber of equipment — or any at all. There is increasing pressure being placed on institutions to provide devices to students and provide more powerful mobile broadband and wireless access.

7) Our organizations are not set up to promote innovation in teaching. Innovation springs from the freedom to connect ideas in new ways. Our schools and universities generally allow us to connect ideas only in prescribed ways — sometimes these lead to new insights, but more likely they lead to rote learning. Current organizational promotion structures reward research instead of innovation and improvements in teaching and learning. The major consequences of student evaluations on teaching, as well as the direct impact on promotion and career options, translates to big risks associated with the failure of innovations and leaves little space for experimentation.

8) There is a need for blended and ICT-mediated learning opportunities in the classroom. Transforming the state of higher education in Latin America calls for the implementation of new pedagogies and technologies. Many emerging methods emphasize personalized learning in order to engage more students and take into account their thinking and learning styles — even those students enrolled in the same courses and programs. However, integrating new teaching approaches that leverage technology has only become a focus for institutions very recently, and there has not yet been enough research conducted on how these approaches can support self-organized learning. In many cases, classrooms are still set up traditionally, with the instructor dispensing lectures.

9) Education systems should encourage the creation of social-cultural learning communities. There is a need to establish communities of practice for faculty and student networks across Latin America to promote awareness of civic culture and marginalized populations and share important research at a large scale. One school of thought leaders believes that integrating these types of communities in higher education will not only make learning experiences more relevant, but equip educators and students with the skills to help solve national and global issues that are germane to the vitality of Latin America.

10) Too often it is education's own processes and practices that limit broader uptake of new technologies. Much resistance to change simply reflects comfort with the status quo. In many cases, experimentation with or piloting of innovative applications of technologies are often seen as outside the role of teacher or school leader, and thus discouraged. Changing these processes will require major shifts in attitudes as much as they will in policy.

Methodology

The process used to research and create the *Technology Outlook > Latin American Higher Education 2013-2018: An NMC Horizon Project Regional Analysis* is very much rooted in the methods used throughout the NMC Horizon Project. All publications of the NMC's Horizon Project are produced using a carefully constructed process that is informed by both primary and secondary research. Dozens of technologies, meaningful trends, and critical challenges are examined for possible inclusion in the report for each edition. Every report draws on the considerable expertise of an internationally renowned advisory board that first considers a broad set of important emerging technologies, challenges, and trends, and then examines each of them in progressively more detail, reducing the set until the final listing of technologies, trends, and challenges is selected.

Much of the process takes place online, where it is captured and placed in the NMC Horizon Project wiki. This wiki, which has grown into a resource of hundreds of pages, is intended to be a completely transparent window onto the work of the project, and contains the entire record of the research for each of the various editions. The section of the wiki used for the *Technology Outlook > Latin American Higher Education 2013-2018* can be found at ibero.wiki.nmc.org.

The procedures for selecting the topics that are in this report include a modified Delphi process now refined over years of producing the *NMC Horizon Report* series, and it began with the assembly of the advisory board. The board as a whole was intended to represent a wide range of backgrounds and interests, yet with each member bringing a particularly relevant expertise. To date, hundreds of internationally recognized practitioners and experts have participated in the NMC Horizon Project Advisory Boards; in any given year, a third of advisory board members are new, ensuring a flow of fresh perspectives each year.

Once the advisory board for a particular edition is constituted, their work begins with a systematic review of the literature — press clippings, reports, essays, and other materials — that pertains to emerging technology. Advisory board members are provided with an extensive set of background materials when the project begins, and are then asked to comment on them, identify those that seem especially worthwhile, and add to the set. The group discusses existing applications of emerging technology and brainstorms new ones. A key criterion for the inclusion of a topic is the potential relevance of the topic to teaching, learning, or creative inquiry. A carefully selected set of RSS feeds from dozens of relevant publications ensures that background resources stay current as the project progresses. They are used to inform the thinking of the participants throughout the process.

Following the review of the literature, the advisory board engages in the central focus of the research — the research questions that are at the core of the NMC Horizon Project. These questions are designed to elicit a comprehensive listing of interesting technologies, challenges, and trends from the advisory board:

1. *Which of these key technologies will be most important to Latin American higher education institutions within the next five years?*

2. *What key technologies are missing from our list? Consider these related questions:*

   a. *What would you list among the established technologies that Latin American higher education institutions and programs are using today that arguably ALL institutions and programs should be using broadly to support or enhance teaching, learning, or creative inquiry?*

   b. *What technologies that have a solid user base in consumer, entertainment, or other industries should Latin American higher education institutions be actively looking for ways to apply?*

c. *What are the key emerging technologies you see developing to the point that Latin American higher education institutions should begin to take notice during the next four to five years?*

3. *What trends do you expect to have a significant impact on the ways in which Latin American higher education institutions approach our core missions of teaching, learning, and creative inquiry?*

4. *What do you see as the key challenges related to teaching, learning, and creative inquiry that Latin American higher education institutions will face during the next five years?*

One of the advisory board's most important tasks is to answer these questions as systematically and broadly as possible, so as to ensure that the range of relevant topics is considered. Once this work is done, a process that moves quickly over just a few days, the advisory board participates in a unique consensus-building activity based on an iterative Delphi-based methodology.

The responses to the research questions are systematically ranked and placed into adoption horizons by each advisory board member using a multi-vote system that allows members to weight their selections. Each member is asked to also identify the timeframe during which they feel the technology would enter mainstream use — defined for the purpose of the project as about 20% of institutions adopting it within the period discussed. (This figure is based on the research of Geoffrey A. Moore and refers to the critical mass of adoptions needed for a technology to have a chance of entering broad use.) These rankings are compiled into a collective set of responses, and inevitably, the ones around which there is the most agreement are quickly apparent.

For additional detail on the project methodology or to review the instrumentation, the ranking, and the interim products behind the report, please visit the project wiki, which can be found at ibero.wiki.nmc.org.

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2013 Latin American Advisory Board