



Horizon Project

2015 NMC Technology Outlook

Brazilian Universities

A Horizon Project Regional Report



2015 NMC Technology Outlook for Brazilian Universities

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2015 NMC Technology Outlook for Brazilian Universities *A Horizon Project Regional Report*

is a collaboration between

The New Media Consortium

and

Saraiva

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An NMC Horizon Project Regional Report

Executive Summary

The *2015 NMC Technology Outlook for Brazilian Universities* is a collaborative research effort between the New Media Consortium and Saraiva to inform Brazilian higher education leaders and decision-makers about important developments in technologies supporting teaching, learning, and creative inquiry in higher education across the country.

All of the research underpinning the *2015 NMC Technology Outlook for Brazilian Universities* 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 developments in technology on teaching, learning, or creative inquiry in Brazilian 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 more than 13 years ago to systematically identify and describe emerging technologies likely to have a large impact on education around the globe.

In the effort that took place from May through July 2015, a carefully selected panel of experts and thought leaders 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 developments in technology, trends, and challenges for Brazilian higher education over the next five years. Known as the 2015 Horizon Project Brazil Expert Panel, that group of thought leaders consists of knowledgeable individuals, all highly regarded in their fields. Collectively the panel represents a range of diverse perspectives across Brazilian higher education.

The project has been conducted under an open data philosophy, and all of the secondary research and discussions can be viewed at brasil.wiki.nmc.org. The precise research methodology employed in producing the report is detailed in a special section found at the end of this report.

The expert panel identified the top 10 key trends, the top 10 significant challenges, and 12 important developments in educational technology. Each of the 12 developments in educational technology are profiled, on a single page that describes and defines the technology, and are ranked as very important for Brazilian higher education over the next year, two to three years, and four to five years. Every page opens with a 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. Preceding those discussions are sections that detail the expert panel's top ranked trends and challenges, illuminating why they are seen as highly influential factors in the adoption of technology across the country.

The three key sections of this report constitute a reference and straightforward technology-planning guide for educators, institutional leaders, administrators, policy-makers, 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 in Brazilian universities.

Introduction

Higher education leaders across Brazil have made great strides over the past five years towards integrating emerging technologies and strategies into teaching and learning. The next five years will be instrumental in furthering this mission.

Indeed, the NMC Horizon Project and the 2015 Horizon Project Brazil Expert Panel recognize that technology adoption in Brazilian higher education is accelerated by trends in policy, leadership, and practice. Therefore, key trends frame the discussion of technology use in Brazilian universities. Similarly, a number of challenges are impeding the proliferation of digital tools, and the panel has identified a set of significant challenges that distinctly reflects the current obstacles facing Brazilian universities over the coming five years. The top three trends and challenges from those longer lists are included in the related tables in this summary, and are organized by categories described in the next sections of this report.

As Table 1 below illustrates, the choices of the Brazil experts overlap in interesting ways with those who contributed to the *NMC Horizon Report > 2015 Higher Education Edition*, which looked at technology uptake from a global perspective, and the *2014 NMC Technology Outlook for Brazilian Universities*, which provides perspective on technology, trends, and challenges across Brazil from last year's Brazilian panel — altogether a group of 140 acknowledged experts.

Table 1: Top-Ranked Trends Across Three NMC Horizon Research Projects

NMC Horizon Report 2015 Higher Education Edition	2015 Technology Outlook for Brazilian Universities	2014 Technology Outlook for Brazilian Universities
Rethinking Learning Spaces	Advancing Cultures of Change and Innovation	Integration of Hybrid Learning Designs
Increasing Use of Hybrid/Blended Learning	Increasing Use of Hybrid Learning Designs	Digital Delivery is Increasingly the Norm
Growing Focus on Measuring Learning	Rise of New Forms of Interdisciplinary Studies	Massive Reinvention of the Personal Computer

The 2015 Brazil panel uniquely surfaced advancing cultures of change and innovation as the highest ranked trend. Leaders of this growing movement believe that universities play a critical role in strengthening national economies. Progress in this area requires Brazilian higher education to ensure greater flexibility, creativity, and entrepreneurial thinking, such as at the Federal University of Bahia, which has three centers on their campus that serve as innovation incubators.¹ Conversely, all three panels are observing the increasing use of hybrid learning models, which blend the best of online and face-to-face learning in order to facilitate greater flexibility and access for students.

Of notable importance to the 2015 Brazilian panel discussions was the rise of new forms of interdisciplinary studies as an increasingly expected element of university life. The concurrent exploration of research in different fields, such as applying quantitative methods to qualitative disciplines has led to entirely new categories of research. For example, the Pontifical University of São Paulo offers advanced degrees in design that combine disparate studies such as science, humanism, and education.²

Horizon Project panels in general have agreed that trends like these are clear drivers of technology adoption; the 2015 Brazil panel 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, which are grounded in everyday realities that make it difficult to learn about, much less adopt, new tools and approaches.

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

NMC Horizon Report 2015 Higher Education Edition	2015 Technology Outlook for Brazilian Universities	2014 Technology Outlook for Brazilian Universities
Integrating Technology in Teacher Education	Personalizing Learning	Increasing Access to Education
Improving Digital Literacy	Integrating Technology in Faculty Education	Reducing the Technology Gap Between Faculty and Students
Creating Authentic Learning Opportunities	Expanding Access	Keeping Education Relevant

As noted in Table 2, at the top of the list of challenges facing Brazilian universities is the act of personalizing learning experiences for students. Brazilian universities need to work to incorporate more personalized learning environments and networks, as well as leverage the power of adaptive learning tools to support self-directed and group-learning experiences that help learners achieve their academic goals. This topic is becoming an increasing priority as education leaders engage in large-scale conversations, such as at the 2015 Bett Education Brazil Conference.³

Both the 2015 Brazil and global panels agreed that integrating technology in teacher training is a daunting challenge, and will require better integration of ICT in curriculum and pedagogy design, along with academic professional development initiatives. For example, the Federal University of Ceará's creation of the course "Teaching Integrated Management of Information and Communication Technologies" is seen as a way to address this obstacle because it not only provides an understanding of digital tools, but it puts those tools into pedagogical practice with undergraduate students.⁴

Both the 2014 and 2015 Brazil panels recognized that expanding access to high-quality educational opportunities is a continuous challenge. The relationship between earning potential and educational attainment, as well as the positive impact of an educated population, is urging the Brazilian government to find ways to provide greater access to education. However, even though a student may be prepared for undergraduate studies, they may not be able to enroll because of current space limitations.⁵ Proponents of online learning believe that it can facilitate easier access to learning materials.⁶

Fueled by the key trends and impeded by significant challenges selected by the panel, the 12 important developments in educational technology presented in the body of this report reflect the experts' opinions as to which of the nearly 50 technologies considered will be most important to Brazilian universities over the five years following the publication of the report.

As Table 3 below illustrates, all three of these projects' expert panels agree that online learning, in some form, will likely tip into mainstream use within the next year — a trend that spans education across much of the world. Brazilian universities epitomize this trend as they are frequently partnering with organizations such as Veduca and Coursera to provide more open online learning opportunities to increase access to high-quality education.⁷

Table 3: Comparison of “Final 12” Topics Across Three NMC Horizon Research Projects

NMC Horizon Report 2015 Higher Education Edition	2015 Technology Outlook for Brazilian Universities	2014 Technology Outlook for Brazilian Universities
Time-to-Adoption Horizon: One Year or Less		
Bring Your Own Device Flipped Classroom Learning Analytics Mobile Apps	Cloud Computing Electronic Publishing Online Learning Social Networks	Flipped Classroom Games and Gamification Mobile Apps Online Learning
Time-to-Adoption Horizon: Two to Three Years		
Collaborative Environments Games and Gamification Makerspaces Wearable Technology	Bring Your Own Device Flipped Classroom Learning Analytics Mobile Learning	Learning Analytics Mobile Learning Open Content Virtual and Remote Laboratories
Time-to-Adoption Horizon: Four to Five Years		
Adaptive Learning Technologies Flexible Displays The Internet of Things Wireless Power	Augmented Reality Semantic Applications Speech-to-Speech Translation Virtual and Remote Laboratories	Augmented Reality The Internet of Things Location Intelligence Virtual Assistants

Additionally, both the 2014 and 2015 Brazilian panels demonstrated consensus around learning analytics being two to three years away from widespread penetration. Many universities in Brazil are starting to pilot learning analytics tools that have built-in analytics to track student learning progress and behavioral patterns, making it easier to identify where they need extra help. The next incarnation of learning analytics is adaptive learning, where the environment responds to individuals' behavior by recommending articles or activities, for example, to a student that has demonstrated the need for more time to grasp the material. Saraiva is developing one such platform to prepare Brazilian students for the Order of Attorneys of Brazil (OAB) exam.⁸

The same two expert panels perceive mobile learning to be in the mid-term horizon; indeed, research for this report indicates that the mobile learning sector in Brazil will be a \$1 million dollar market by 2019. Leading the way are education publishers who are increasingly making their learning products optimized for mobile use. Both panels are also in agreement that augmented reality will emerge as an important educational tool in the far-term horizon. Experiments with virtual and augmented reality are primarily taking place in university medical research in Brazil, such as at the Federal University of Minas Gerais, which is using augmented reality to increase the post-stroke walking speeds for chronic stroke patients.⁹

These points and comparisons provide an important context for the main body of the report that follows.

Key Trends Accelerating Technology Adoption

The developments in technology 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. To assure this perspective, each panel member researches, identifies, and ranks key trends that are currently affecting policy, leadership, and practice in higher education across Brazil, and uses these as a lens for the work of predicting the uptake of emerging technologies. These ten trends, which the panel agreed are very likely to strongly influence technology planning and decision-making over the next five years, were ranked in order of importance by the expert panel, with the first trend listed being deemed the most impactful.

1. Advancing Cultures of Change and Innovation. Many thought leaders have long believed that higher education can play a major role in the growth of national economies and living standards more generally.¹⁰ In order to breed innovation and adapt to economic needs, institutions must be structured in ways that allow for flexibility, and spur creativity and entrepreneurial thinking. There is a growing consensus among many thought leaders that higher education leadership and curricula could benefit from agile startup models.¹¹ Innovation is ingrained in the culture of the Federal University of Bahia, which has three creative centers that involve the academic community in activities ranging from innovation law to the development of new technologies.¹²

2. Increasing Use of Hybrid Learning Designs. Over the past several years, perceptions of online learning have been shifting in its favor as more learners and educators see it as a viable alternative to some forms of face-to-face learning.¹³ The advent of MOOCs may be a factor in online learning gaining increasing credibility amongst traditional Brazilian universities. Drawing from best practices in online and face-to-face methods, hybrid learning is on the rise at institutions, such as the University of Sao Paulo and the State University of Campinas, which have partnered with Coursera and Veduca.¹⁴ The affordances hybrid learning offers are now well understood, and its flexibility, ease of access, and the integration of sophisticated multimedia and technologies are high among the list of appeals.

3. Rise of New Forms of Interdisciplinary Studies. According to the Melbourne Sustainable Society Institute, multidisciplinary research refers to concurrent exploration and activities in seemingly disparate fields.¹⁵ Researchers, along with academic technologists and developers, are breaking new ground in this area. The Pontifical University of São Paulo's Master's and Doctorate degrees in Technologies of Intelligence and Digital Design, for example, is an interdisciplinary program that brings together scientific, humanistic, and educational techniques into a coherent unit. These emerging areas could lead to exciting new developments in education, but effective organizational structures will need to be in place to support this collaboration.¹⁶

4. Proliferation of Open Educational Resources. Defined by the Hewlett Foundation in 2002, open educational resources (OER) are "teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others."¹⁷ There has been a rise in free online services, including TED talks and Wikipedia. Advocates of openness have worked toward a common vision that defines OER as not just free in economic terms, but also in terms of ownership and usage rights.¹⁸ In cooperation with UNESCO, Unicamp recently inaugurated a chair to promote a collaborative network around open education and open education resources.¹⁹

5. Redesigning Learning Spaces. New forms of teaching and learning require revamped spaces for teaching and learning. More universities are helping to facilitate these emerging models of education, such as the flipped classroom, by rearranging learning environments to accommodate more active learning.²⁰ Both formal and informal educational settings are increasingly designed to

facilitate project-based interactions with attention to mobility, flexibility, and multiple device usage. At Uniamérica in Foz do Iguaçu, educational spaces are designed to facilitate active learning, allowing for interactive, interdisciplinary, and peer-to-peer activities.²¹

6. Shift to Deeper Learning Approaches. There is a new emphasis in the classroom on deeper learning approaches, defined by the Alliance for Excellent Education as the delivery of rich core content to students in innovative ways that allow them to learn and then apply what they have learned.²² Project-based learning, problem-based learning, inquiry-based learning, challenge-based learning, and similar methods are fostering more active learning experiences, both inside and outside the classroom. In late 2015, Rio de Janeiro Federal University and the Federal University of Santa Catarina will participate in CITYLABS, a European – Latin American initiative that will integrate problem-based learning into architecture, urban planning, and engineering.²³

7. Rethinking How Universities Work. There is a focused movement to reinvent the traditional classroom paradigm and rearrange the entire university experience — a trend that is largely being driven by the influence of innovative learning approaches.²⁴ The multidisciplinary nature of project-based learning and other contemporary approaches has brought attention to innovative designs of the university atmosphere that link each class and subject matter to others. The Brazilian Academy of Sciences addressed this trend at their International Symposium on Excellence in Higher Education. It examined successful models of redesigning educational and research institutions to strengthen Brazil's international role in science, technology, and innovation.²⁵

8. Growing Focus on Measuring Learning. There is an increasing interest in using data for personalizing the learning experience, for ongoing formative assessment of learning, and for performance measurement.²⁶ This interest is spurring the development of a relatively new field — data-driven learning and assessment. Key elements of this trend are the gathering and analyzing of large amounts of detail about individual student interactions in online learning activities, providing insights into student progress. At the University Center Tiradentes, Federal University of Rio Grande do Sul, and Federal University of Viçosa, students are using clickers and personal response system software to diagnose areas of study where students are struggling.²⁷

9. Shift from Students as Consumers to Students as Creators. A shift is taking place in the focus of pedagogical practice in universities around the world as students across a wide variety of disciplines are learning by making and creating rather than from the simple consumption of content.²⁸ Creativity, as illustrated by the growth of user-generated videos, maker communities, and crowd-funded projects, is increasingly the means for active, hands-on learning. Physiotherapy students at University Ibirapuera, for example, developed an educational game called Bacteria Hunters that taught children the dangers of bacteria in a fun and dynamic way.²⁹

10. Increasing Cross-Institution Collaboration. Collective action among universities is growing in importance for the future of higher education in Brazil. More and more, institutions are joining consortia — associations of two or more organizations — to combine resources or to align themselves strategically with innovation in higher education.³⁰ Today's global environment is allowing universities to unite across international borders and work toward common goals concerning technology, research, or shared values. Unicamp, for example, is now part of the Structural Genomics Consortium, an international academic group of biological and biomedical researchers.³¹

Significant Challenges Impeding Technology Adoption

Along with the trends discussed in the preceding section, the expert panel noted a number of significant challenges faced in higher education across Brazil that are impeding the uptake of emerging technologies. Because not all challenges are of the same scope, the discussions were framed by three categories defined by the nature of the challenge. The NMC Horizon Project defines solvable challenges as those that we both understand and know how to solve; difficult challenges are ones that are more or less well understood, but for which solutions remain elusive. Wicked challenges, the most difficult, are categorized as complex to even define, and thus require additional data and insights before solutions will even be possible. The expert panel ranked challenges in order of significance, with the first challenge listed being deemed the most prominent.

1. Personalizing Learning. Personalized learning includes a wide variety of approaches to support self-directed and group-based learning that can be designed around each learner's goals.³² Solving this challenge means incorporating into classroom activities concepts such as personalized learning environments and networks, adaptive learning tools, and more. Adaptive learning, which envisions the development of tools and data streams, is still some time away from mainstream use in Brazilian universities. It 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 was the focus of a lecture at the Bett Education Brazil conference in 2015.³³ While the concept of personalized learning is fairly fluid, it is becoming more clear that it is individualized by design, different from person to person, and built around a vision of life-long learning.

2. Integrating Technology in Faculty Education. 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.³⁴ The lack of formal training for lecturers is being offset through informal learning and ad hoc professional development, but higher education is far from seeing digital literacy as the 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. The Federal University of Ceará is addressing this challenge through the creation of the course "Teaching Integrated Management of Information and Communication Technologies," whose goal is to help faculty understand and use ICT in pedagogical practice.³⁵

3. Expanding Access. The global drive to increase the number of students participating in undergraduate education is placing pressure across the system. The oft-cited relationship between earning potential and educational attainment plus the clear impact of an educated society on the growth of the middle class is pushing governments to encourage more and more students to enter universities and colleges.³⁶ In Brazil, not every student prepared for undergraduate study can enroll on a traditional college campus because of space limitations.³⁷ Online learning in Brazil is seen as a way to facilitate access for students because it is more convenient with flexible hours and smaller fees than traditional coursework.³⁸

4. Rethinking the Roles of Educators. Educators are increasingly expected to be adept at a variety of technology-based and other approaches for content delivery, learner support, and assessment; to collaborate with other educators both inside and outside their universities; to routinely use digital strategies in their work with students; to act as guides and mentors to promote student-centered learning; and to organize their own work and comply with administrative documentation and reporting requirements.³⁹ The College La Salle do Rio Verde recently presented at the II International Congress on Education to discuss this challenge. The theme was the professor as mediator, highlighting the need to modify the roles of educators.⁴⁰

5. Creating Authentic Learning Opportunities. Authentic learning, especially that which brings real-life experiences into the classroom, is still all too uncommon in Brazilian universities. Authentic learning is seen as an important pedagogical strategy, with great potential to increase the engagement of students who are seeking some connection between the world as they know it exists outside of the institution, and their experiences that are meant to prepare them for that world.⁴¹ Use of learning strategies that incorporate real life experiences, such as the course FEIMARC at the Federal University of Goiás where students designed and implemented marketing research projects based on raw materials like cocoa, are making progress in this area.⁴²

6. Under-resourced Campus Infrastructure. Critical school infrastructures are under-resourced, and in Brazil, it is cited as one of the reasons for shortcomings in preparing ICT professionals.⁴³ Rather than encouraging researchers to build on and extend core resources, leverage shared file systems, and open accessible service APIs, institutions are narrowing their focus to what they perceive as the minimal subset of enterprise services they can afford to sustain. As a result, educators are often trying to design new, innovative learning models that must be integrated with outdated, pre-existing technology and learning management systems.

7. Scaling Teaching Innovations. Brazilian universities are not adept at moving teaching innovations into mainstream practice. Innovation springs from the freedom to connect ideas in new ways.⁴⁴ Our 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. A pervasive aversion to change limits the diffusion of new ideas, and too often discourages experimentation. Developing a culture of innovation was the focus of the UNESP Innovation and Accessibility in Higher Education meeting, where thought leaders stressed the importance of enhancing teaching practices through distance learning.⁴⁵

8. Managing Knowledge Obsolescence. Simply staying organized and current presents a challenge in a world where information, software tools, and devices proliferate at the rate they do today.⁴⁶ New developments in technology are exciting and their potential for improving quality of life is enticing, but it can be overwhelming to attempt to keep up with even a few of the many new tools that are released. Digital preservation strategies and systems are important aspects of this challenge. Minimizing the effects of technological obsolescence is the focus of a recent report, “The Vulnerabilities of Digital Document,” published by the Federal University of Santa Maria.⁴⁷

9. Balancing our Connected and Unconnected Lives. With the abundance of content, technologies, and overall participatory options, learning institutions need to lead the way to facilitate finding a balance between connected and unconnected life.⁴⁸ With technology now at the center of many daily activities, as in Brazil where social network users spend nearly four hours per day online,⁴⁹ it is important that learners understand how to balance their connected life with other developmental needs. Higher education institutions should ensure learners do not get lost and absorbed by the abundance of information and technology, and encourage mindful use of technology so that students stay aware of their digital footprint.

10. Improving Digital Literacy. With the proliferation of the Internet, mobile devices, and other technologies that are now pervasive in education, the traditional view of literacy as the ability to read and write has expanded to encompass understanding digital tools and information.⁵⁰ This new category of competence is affecting how Brazilian institutions address literacy issues in their curriculum objectives and teacher development programs. The virtual panel “Century Skills 21: Revelations and Reflections about Digital Literacy for the Portuguese Language” convened experts in this area. The goal was to promote the exchange of digital literacy projects from different scientific fields.⁵¹

Time-to-Adoption: One Year or Less

Cloud Computing

Cloud computing refers to expandable, on-demand services and tools that are served to the user via the Internet from specialized data centers and consume almost no local processing or storage resources. Cloud computing resources support collaboration, file storage, virtualization, and access to computing cycles, and the number of available applications that rely on cloud technologies has grown to the point that few education institutions do not make some use of the cloud, whether as a matter of policy or not. Over the past few years, cloud computing has been firmly established as an efficient way for businesses to protect data, develop applications, deliver software and online platforms, and to collaborate.⁵² Indeed, according to a survey conducted by Frost & Sullivan consultancy, cloud computing in Brazil is projected to increase by \$1.1 billion in revenues by 2017, compared to \$328.8 million in 2013.⁵³

Relevance for Teaching, Learning, or Creative Inquiry

- The adoption of cloud-based platforms and services provides a more flexible means of adjusting a university's infrastructure and technology portfolio to the needs of the moment.
- Cloud resources are often free and very simple to use, making access to storage, tools, media, and educational materials much more accessible than ever before.
- Online access to documents and applications facilitates greater flexibility, enabling students and faculty to create and edit their own materials and to consult and review information wherever and whenever they need it.

Cloud Computing in Practice

- The Cloud Forest Project, a climate and ecology study by the São Paulo Research Foundation and the University of Campinas, uses the cloud-based Microsoft Azure platform to aggregate and analyze microclimate data: go.nmc.org/clofor.
- Microsoft Research has partnered with the Federal University of Minas Gerais on the Traffic Prediction Project, which runs data through algorithms in the cloud and shares information on future traffic conditions: go.nmc.org/traff.
- RNP, which provides network infrastructure to public universities and research institutions, is testing a hybrid model where universities receive cloud computing services in exchange for integrating their infrastructure with RNP's national cloud: go.nmc.org/rnpcloud.

For Further Reading

Harnessing the Power of Cloud Computing Through E-Science Central

go.nmc.org/cloudcon

(Stephanie Parker, *International Science Grid Week*, 19 February 2014.) An interview with the e-science central team revealed the European and Brazilian initiative EU Brazil Cloud which is working with the Federal University of Campina Grande. The project is exploring how their cloud-based system can facilitate large-scale international research projects.

The Commodification of Information Commons: The Case of Cloud Computing (PDF)

go.nmc.org/infocom

(Primavera De Filippi and Miguel Said Vieira, *The Columbia Science & Technology Law Review*, Fall 2014.) This article presents strategies for structuring cloud computing services in a decentralized manner to maximize openness and access. These considerations should prove useful to academic institutions that aim to promote knowledge and collaboration through the creation of information commons.

Time-to-Adoption: One Year or Less

Electronic Publishing

Already firmly established in the consumer sector, electronic publishing is redefining the boundaries between media and how we interact with it. Modern digital workflows support almost any form in which content might appear, from traditional print to digital, web, video, and even interactive content. Building in the full spectrum of potential publishing avenues from the beginning is not only a way to streamline production overall, but also to increase the reach of the materials produced by leveraging the content over a wide range of media. If the first revolution in electronic publishing was making publishing platforms accessible to anyone, the next phase is the linking of these platforms together to produce new combinations and new types of content. Electronic publications, such as the Federal University of Piauí Center for Research in Literature's *Contramão Magazine*, allows content to be easily archived as well as ported to any device.⁵⁴

Relevance for Teaching, Learning, or Creative Inquiry

- Electronic publications are easy to download and use, and are accessible on devices from mobiles to tablets to dedicated readers.
- Electronic publishing offers universities unprecedented opportunities of scale and richness by reorganizing the way images, audio and video content, and layers of textual data are conceptualized during the design process.
- Modifying publishing workflows to allow for multiple delivery media brings universities in line with industry-standard practices in the consumer publishing space.

Electronic Publishing in Practice

- The Digital Library of Theses and Dissertations (BDTD) of the University of São Paulo (USP), the largest library of its kind in Latin America, recently surpassed 50,000 digital titles. The BDTD provides an opportunity for USP scholars to showcase their work on a worldwide scale: go.nmc.org/bdtd.
- The Oliveira Lima Library has partnered with educational publishing company Gale to digitize and archive a large collection of rare materials from the 19th century that originally belonged to Brazilian diplomat and historian Manoel de Oliveira Lima: go.nmc.org/olima.
- Saraiva's scholastic division has rolled out plans to adapt its educational content and textbooks into digital formats, including game platforms and e-books for distance learning: go.nmc.org/edudig.

For Further Reading

Is SciELO a Publication Favela?

go.nmc.org/scielo

(*Scholarly Open Access*, 30 July 2015.) This article explains the aggregation and distribution process of academic digital publishing platforms. The Brazilian government's plan to increase exposure for Brazilian scholarly content was halted due to issues with the bidding process by publishing companies.

London Book Fair 2015: Brazil's Race to Digital

go.nmc.org/esale

(Carlo Carrenho, *Publishers Weekly*, 14 April 2015.) Challenges facing digital book sales in Brazil include a lack of major aggregators for digital distribution and regulatory uncertainty on e-book taxation. Educational publishers await government guidance on digital content requirements.

Time-to-Adoption: One Year or Less

Online Learning

Online learning refers to both formal and informal educational opportunities that take place through the web. This topic experienced a surge of interest with the rise of massive open online courses in 2012, and has since been garnering greater acceptance as a mode of learning that can complement face-to-face instruction in hybrid learning approaches — or stand on its own. As leaders have gained a better understanding of this field, they have been conducting numerous related online learning experiments; educators are becoming more comfortable testing various levels of integration in their existing courses, and many believe that online learning can be an effective catalyst for thoughtful discussion on all pedagogical practice.⁵⁵ Indeed, online learning is undergoing a sea change, with every dimension of the process open for reconceptualization.⁵⁶ Online learning is growing rapidly in Brazil; it is the fifth largest market for Coursera, which has created 28 Portuguese language courses.⁵⁷

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 makes creative use of educational technologies and emerging instructional approaches, including hybrid 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

- Descomplica, an educational video platform with 12 million subscribers, is disrupting Brazil's test preparation course market by making online learning affordable, entertaining, and accessible: go.nmc.org/descom.
- EduK, a Brazilian startup, offers live streaming courses on a variety of topics. The lessons can assist the self-employed in managing their businesses and help unemployed people acquire new vocational skills: go.nmc.org/eduklive.
- Online education provider Coursera has partnered with the University of São Paulo and the State University of Campinas to develop Portuguese-language courses in finance and entrepreneurship: go.nmc.org/portfin.

For Further Reading

Innovating for Change in Higher Education

go.nmc.org/techint

(Doug Gray, *The Report*, 18 May 2015.) In order to remain competitive with the booming for-profit education sector and meet students' changing needs, Brazilian non-profit universities and religious institutions must invest in technology-oriented learning solutions and engage in international collaborations.

Online Learning: Bending the Cost Curve in Higher Education?

go.nmc.org/flexcost

(Gabriel S. Zinny, *EdTechReview*, 26 June 2015.) The emerging economies of Latin America stand to benefit greatly as online education offerings increase. The flexibility and lower cost of online learning provide opportunities and access to populations that were traditionally shut out of higher education.

Time-to-Adoption: One Year or Less

Social Networks

Today's web users are prolific creators of content, and they upload photographs, audio, and video to cloud-based social networks such as Facebook, Pinterest, Twitter, YouTube, Flickr, and many others by the billions. While the initial emphasis of social networks 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. The Pew Digital Convergence Survey positioned Brazil seventh in a global ranking of Internet usage at 75% of adult daily usage -- 82% of those surveyed used social networking applications such as Facebook or Twitter to keep in touch with family and friends.⁵⁸ 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.⁵⁹

Relevance for Teaching, Learning, or Creative Inquiry

- Engagement in social networks either as producers of content, consumers, or aggregators of user-generated content allow academics to more deeply connect with each other.
- Social networks enable 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 instructional videos that students can watch anywhere. Similarly, Google Hangouts allow them to connect with students outside of the classroom.

Social Networks in Practice

- Facebook has opened an innovation lab in Heliópolis, a low-income community outside São Paulo, to provide entrepreneurs with training in social media management and marketing: go.nmc.org/facelab.
- Professors from Portugal have created a Portuguese-language guide to social media for scientists with the potential to aid the Brazilian scientific community in sharing discoveries and bringing attention to the issue of government cuts in research spending: go.nmc.org/scigui.
- Tyngu, a learning platform, offers tutorials on basic social media for business. Brazilians who are already active on social networks can learn to manage business accounts to reach new customers: go.nmc.org/tyngu.

For Further Reading

Anti-Racism Campaign Reveals the Struggles of Minorities on Brazil's College Campuses
go.nmc.org/smaware

(Diego Iraheta, *Huffington Post Brazil*, 10 April 2015.) As affirmative action laws increase diversity in Brazilian university enrollment, students at the University of Brasília have contributed to a social media campaign to raise awareness of prejudice on campus.

Why Brazil is Actually Winning the Internet
go.nmc.org/brazwin

(Julie Ruvolo, *Buzzfeed*, 29 June 2014.) Brazil is home to avid social media users that comprise the second-largest market (after the U.S.) for social networks Facebook, Twitter, and Tumblr. Brazilians also use homegrown media platforms Meu Rio and MidiaNINJA to collaborate and bring attention to social justice issues.

Time-to-Adoption: Two to Three Years

Bring Your Own Device

BYOD, also referred to as BYOT (Bring Your Own Technology), refers to the practice of people bringing their own laptops, tablets, smartphones, or other mobile devices with them to the learning or work environment. Intel coined the term in 2009, when the company observed that an increasing number of its employees were using their own devices and connecting them to the corporate network. Since implementing BYOD policies, the company has reported up to 5 million hours of annual productivity gains, a statistic that is compelling many other companies to consider BYOD.⁶⁰ In higher education, the BYOD movement addresses the same reality; many students are entering the classroom with their own devices, which they use to connect to the institutions' networks. While BYOD policies have been shown to reduce overall technology spending, they are gaining traction more so because they reflect the contemporary lifestyle and way of working. A 2014 Tech Pro Research survey found that 74% of respondents said that they are using or planning to implement BYOD in their organization.⁶¹ Although administrators and educators have cited IT security concerns, technology gap issues, and platform neutrality as challenges to the uptake of this technology, a growing number of models in practice are paving the way for BYOD to enter the mainstream. With over 275 million mobile users in Brazil and counting, this practice will only increase.⁶²

Relevance for Teaching, Learning, or Creative Inquiry

- Because BYOD allows students access to the same devices at school and at home, it can extend learning opportunities to times and places outside of the lecture hall.
- BYOD policies allow students to work with technology with which they are already comfortable and familiar.
- BYOD programs eliminate the support and other demands placed on universities that accompany paying for and maintaining institution-provided devices.

Bring Your Own Device in Practice

- As the BYOD/BYOT trend continues, nearly one-third of the country's public universities have partnered with Ruckus Wireless to deploy wireless Internet connections on their campuses: go.nmc.org/ruckus.
- In response to increased mobile demand as students use smartphones and other devices for learning, the Catholic University of Brasília now provides more comprehensive wireless Internet access and faster download speeds: go.nmc.org/ucbnet.
- The University of Brasília offers a device-neutral wireless network with data and voice capability on its campus. Students from the Applied Computing discipline are analyzing the network to improve services and pilot-test new features: go.nmc.org/unbnet.

For Further Reading

The Challenges of Supporting BYOD Culture on College Campuses

go.nmc.org/byodcc

(Kristen Hicks, ExamSoft Blog, 2 April 2015.) As technology and learning become more integrated and students use more devices on campus, higher education institutions must prepare for issues of security, access, and infrastructure costs.

In Latin America, Brazil Takes Top Spot for Total Tablet Users

go.nmc.org/toptab

(eMarketer, 23 January 2015.) Nearly 35 million Brazilians, or one in three Internet users, are expected to use tablets this year. Models indicate that market penetration will continue to grow, with over 48 million Brazilian tablet users predicted for 2018.

Time-to-Adoption: Two to Three Years

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.⁶³ In the flipped classroom model, valuable class time is devoted to higher cognitive, 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. Rather than the instructor using class time to 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, or collaborating with peers in online communities. Students access the online tools and resources any time they need them. Faculty can then devote more time to interacting with each individual. After class, students manage the content they use, the pace and style of learning, and the ways in which they demonstrate their knowledge; the instructor adapts instructional and collaborative approaches to suit their learning needs and personal learning journeys.

Relevance for Teaching, Learning, or Creative Inquiry

- Flipped classroom concepts, along with providing students with a more diverse set of learning resources, support self-directed learning.
- More active learning is an important component of the flipped classroom: lectures are watched with ensuing online discussions unfolding at home, while professors use class time for hands-on activities or trips outside of the building.
- The online component of the flipped classroom enables students to repeat vital learning activities, such as re-watching video lectures and running virtual experiments as often as needed, in order for them to fully grasp the subject matter.

Flipped Classroom in Practice

- Albert Sabin College has adopted the flipped classroom model, leading to livelier in-class discussions, more personalized learning, and increased connections between students and teachers: go.nmc.org/asflip.
- The Director of Distance Education at the Methodist University of São Paulo has called for new initiatives to train teachers in flipping their classrooms, and envisions a network of universities offering educational television on demand: go.nmc.org/distflip.
- Veduca, a Brazilian MOOC, aims to democratize learning by increasing access and to improve the quality of the conventional classroom format by encouraging the adoption of the flipped learning model: go.nmc.org/flipmooc.

For Further Reading

Blended Learning and Changes in Higher Education: The Inverted Classroom Proposal
go.nmc.org/flipble

(José Armando Valente, *Educar em Revista*, 8 December 2014.) This article defines various frameworks for blended learning and describes successful flipped university courses. Teachers wishing to flip their classrooms should set clear objectives for students and request feedback to meet the needs of their students.

Improvements from a Flipped Classroom May Simply Be the Fruits of Active Learning
go.nmc.org/alfliip

(Jamie L. Jensen et al., *CBE Life Sciences Education*, 2 March 2015.) Researchers from Potiguar University and Brigham Young University compared two university biology courses, one using the flipped classroom method. They concluded that the flipped classroom can facilitate a shift toward active learning, if not already present.

Time-to-Adoption: Two to Three Years

Learning Analytics

Learning analytics is an educational application of web analytics, a science that is commonly used by businesses to analyze commercial activities, identify spending trends, and predict consumer behavior. Education is embarking on a similar pursuit into data science with the aim of learner profiling, a process of gathering and analyzing large amounts of detail about individual student interactions in online learning activities. The goal is to build better pedagogies, empower students to take an active part in their learning, target at-risk student populations, and assess factors affecting completion and student success. For learners, educators, and researchers, learning analytics is already starting to provide crucial insights into student progress and interaction with online texts, courseware, and learning environments used to deliver instruction. 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 faculty to address issues quickly.
- The science behind learning analytics in online environments can be used to create adaptive software that caters to a student's individual learning curve in real time.
- When correctly applied and interpreted, learning analytics will enable faculty to more precisely identify students' learning needs and tailor instruction appropriately.

Learning Analytics in Practice

- Aiming to combat the problem of university drop-out rates and improve learning outcomes, Positive University students developed a mobile platform to evaluate the efficacy of teaching methodologies in real time: go.nmc.org/upplat.
- High school graduates use Geekie Games to prepare for the ENEM exam to gain university admission. The learning platform provides instant feedback and correction, helping students to stay on track: go.nmc.org/enemex.
- Saraiva has released a digital adaptive learning platform to aid students studying for the Order of Attorneys of Brazil (OAB) exam. Students can use the software to identify their strongest and weakest topics and develop personal study plans: go.nmc.org/oabex.

For Further Reading

Dropout Prediction and Reduction in Distance Education Courses with the Learning Analytics Multitrail Approach (PDF)

go.nmc.org/ladrop

(Wagner Cambuzzi et al., *Journal of Universal Computer Science*, 10 January 2015.)

Researchers found that distance education professionals can use learning analytics data to reduce attrition rates by instigating specific pedagogical actions in response to data.

Integration Service Development of Informal Learning Activities within the Distance Education in Brazil (PDF)

go.nmc.org/intple

(Ivanildo J. de Melo Filho et al., *2015 Annual Conference of the EU-SPRI Forum Proceedings*, June 2015.) Teachers monitor online students' performances through learning management systems (LMS), but do not receive data on informal learning taking place within the students' extended personal learning environments (PLE). Researchers are investigating informal learning practices to determine the utility of a service that integrates the learner's PLE with the course LMS.

Time-to-Adoption: Two to Three Years

Mobile Learning

As smartphones and tablets become more capable and user interfaces more natural, old methods of computing seem place-bound and much less intuitive. People increasingly expect to be connected to the Internet and the rich tapestry of knowledge it contains wherever they go, and the majority of them use a mobile device to do so. According to Gartner, by 2018, 50% of users will access online activities first through tablets or smartphones.⁶⁴ The unprecedented evolution of these devices and the apps that run on them has opened the door to myriad uses for education. Learning institutions all over the world are adopting apps into their curricula and modifying websites, educational materials, resources, and tools so they are optimized for mobile devices. The significance for teaching and learning is that these devices have the potential to facilitate almost any educational experience, allowing learners to organize virtual video meetings with peers all over the world, use specialized software and tools, and collaborate on shared documents or projects in the cloud, among many other things.

Relevance for Teaching, Learning, or Creative Inquiry

- As a one-to-one solution, mobiles present 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 Dropbox make it possible to exchange notes, assignments, and media.
- 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 record interviews, collect data for experiments, and more.

Mobile Learning in Practice

- Brazil's CNA Language School has created Hello Pizza, a mobile app. Customers of a California pizzeria receive discounts for completing their order through the app, which connects the customers to CNA students practicing English language skills in real time: go.nmc.org/pizza.
- Students preparing for the Order of Attorneys of Brazil exam can access seven free mobile apps via smartphone or tablet device to aid their studies: go.nmc.org/oabapp.
- The University of São Paulo has released a mobile app, "USP Libraries." Users can search all of the campus's catalogs and content, and the app allows smartphones to read barcodes: go.nmc.org/usplib.

For Further Reading

Mobile Learning in Brazil Spikes to \$1 Billion by 2019

go.nmc.org/brmobile

(*Yahoo! Finance*, 28 May 2015.) Research predicts that the Brazilian mobile learning sector will be a \$1 billion market by 2019. Education publishers are moving to mobile formats, and demand for English-language learning products and mobile educational games continue to grow.

Ten Trends of Technology in Education

go.nmc.org/brtrend

(Paula Adamo Idoeta, *BBC Brasil*, 6 December 2014.) Teachers are harnessing technology such as mobile apps, tablets, games, and learning platforms to facilitate personalized learning, help students become content creators, and keep students engaged.

Time-to-Adoption: Four to Five 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),⁶⁵ new uses seem to emerge almost daily. 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 in a form easy to understand and work with.

Relevance for Teaching, Learning, or Creative Inquiry

- Augmented reality constructs provide contextual, in situ learning experiences that foster exploration of real world data in virtual surroundings and simulations.
- Games that are based in the real world and augmented with networked data give educators powerful new ways to show relationships and connections in computer science.
- Students doing outdoor fieldwork access AR applications to overlay maps and information about their surroundings, or to enter field observations and data that are automatically geocoded as the records are created.

Augmented Reality in Practice

- Preliminary research from Guilherme Guimbala College indicates that virtual reality applications can assist hemiparetic stroke victims with improving motor recovery and muscle dexterity, and participants reported increased quality of life: go.nmc.org/vrhelphelp.
- Researchers from Federal University of Minas Gerais and other institutions found that chronic stroke patients were able to increase their post-stroke walking speed using a virtual reality-based walking training regimen: go.nmc.org/brwalk.
- The Virtual and Augmented Reality Group at Federal University of Uberlândia, Brazil has developed a virtual reality rehabilitation program to aid post-operative breast cancer patients in regaining full mobility in the upper limbs and trunk: go.nmc.org/grva.

For Further Reading

Augmented Reality for Blended Language Learning (PDF)

go.nmc.org/arblend

(Sora Lim and Boeun Jung, *International Journal of Multimedia and Ubiquitous Engineering*, December 2014.) In contrast to other multimedia features that introduced distraction for learners, researchers found that the addition of mobile AR elements to a Brazilian Portuguese language-learning curriculum produced an immersive and customizable learning experience.

The State of the Art in Virtual Reality Applied to Digital Games: A Literature Review (PDF)

go.nmc.org/vrgame

(Breno Carvalho et al., *Proceedings of the 5th International Conference on Applied Human Factors and Ergonomics AHFE 2014*, July 2014.) This article details the evolution of virtual reality from the 1980s-present, and discusses the cognitive utility of immersive VR games for learning and training, with a focus on health and education applications.

Time-to-Adoption: Four to Five Years

Semantic Applications

Semantic-aware applications infer the meaning, or semantics, of information on the Internet using metadata to make connections and provide answers that would otherwise be elusive or altogether invisible. In the 1960s, the Library of Congress developed and released the first protocol for linked metadata, the machine-readable cataloging format, or MARC, as it is commonly known. Advances in these standards and search engine analytics are connecting library catalog systems on the Internet, and using linked data to help users uncover and delve into hidden content.⁶⁶ Semantic searching most frequently applies to scientific inquiries, allowing researchers to gather an abundance of relevant, credible information without using a dozen search tools. These emerging Internet technologies have the potential to revolutionize research, unearth troves of scientific knowledge, and transform the way academic stakeholders pursue purposeful investigations.⁶⁷

Relevance for Teaching, Learning, or Creative Inquiry

- Academic research can be a more valuable information resource if their metadata is an interoperable part of the Semantic Web and not siloed in separate inaccessible databases.
- Semantic-aware applications are intended to assist with searching and finding, with making intellectual or social connections. Semantic searching is currently used primarily to streamline scientific inquiries, allowing researchers to find relevant information without having to deal with apparently similar, but irrelevant, information.
- The university community is poised to make real strides into the world of the semantic web with projects like BIBFRAME, which serves as a general model for expressing and connecting bibliographic data.

Semantic Applications in Practice

- ISCOOL is an educational game platform aimed at low-literacy and disabled populations. The game assists learners with critical analysis and textual interpretation using semantic technologies: go.nmc.org/iscool.
- Researchers from the University of São Paulo have created a structured methodology to analyze various types of gene expression data using scalable semantic web services: go.nmc.org/restsw.
- Professors from several universities gathered for the Seventh Brazilian Workshop on Semantic Web and Education to share innovations in teaching and learning using semantic technologies: go.nmc.org/swconf.

For Further Reading

LDaaSWS: Toward Linked Data as a Semantic Web Service

go.nmc.org/linksw

(Leandro José Silva Andrade and Cássio V. S. Prazeres, *Proceedings of Tenth International Conference on Internet and Web Applications and Services*, 21 June 2015.) This paper proposes a method (LDaaSWS, Linked Data as a Semantic Web Service) to integrate Web Service based applications and Web of Data applications.

Semantic Solutions for the Digital Libraries Based on Semantic Web Technologies

go.nmc.org/libsw

(Shriram Pandey and K. C. Panda, *Annals of Library and Information Studies*, December 2014.) This article presents challenges and strategies for libraries using semantic technologies. Integration of semantic software and web applications into digital libraries can empower users by making information more accessible and increasing community collaboration.

Time-to-Adoption: Four to Five Years

Speech-to-Speech Translation

No longer in the realm of science fiction, the concept of a real-time universal translator is currently in the works as pioneering companies such as Google and Facebook are acquiring and developing technologies that support speech recognition, language translation, and speech synthesis. In 2006, an advancement that led to the development and use of layered models of inputs, termed deep neural networks (DNN), brought speech recognition to its highest level of accuracy yet, clearing the way for speech-to-speech translation.⁶⁸ As a result, today's consumers are habitually interacting with voice-activated virtual assistants on their mobile phones and even in their vehicles with greater ease and comfort. Researchers are now applying DNN to automatic translation engines in efforts to increase the semantic accuracy of interpreting the world's languages, and Microsoft engineers have already demoed software that can synthesize an individual's own voice in another language, from English to Mandarin.

Relevance for Teaching, Learning, or Creative Inquiry

- As speech-to-speech translation continues to advance, it is opening up a world of new learning resources as both teachers and faculty are able to access videos and podcasts in other languages that they previously would not have been able to comprehend.
- More sophisticated translation tools are improving virtual assistants, enabling voice activated services like Cortana and Siri to be more effective in responding to instructors' and students' searches and requests.
- Speech-to-speech translation can be leveraged for cultural and foreign exchange programs, enabling Brazilian students to more easily connect with pen pals from all over the world.

Speech-to-Speech Translation in Practice

- Education First (EF) has partnered with the Brazilian Olympic Committee and the Ministry of Education to help one million Brazilians learn English through its learning platform EF Englishtown. The language portal contains advanced speech recognition software to improve learners' pronunciation: go.nmc.org/efeng.
- Google Translate now provides instant voice translation services in 36 languages, including Portuguese. The app uses machine learning, and accuracy will improve as users supply more data: go.nmc.org/gtinst.
- Microsoft's Skype Translator offers instant translation of text chats in over 40 languages, including Portuguese: go.nmc.org/rtsky.

For Further Reading

How Google Translate Squeezes Deep Learning onto a Phone

go.nmc.org/gtneur

(Otavio Good, Google Research Blog, 29 July 2015.) Brazilian Otavio Good, creator of the Word Lens technology that powers Google Translate's instant printed word translation, explains how Google engineers developed a compact neural network that accounted for real-world variations in printed letters.

What Would a World Without Language Barriers Look Like?

go.nmc.org/wwlb

(Joe Pinsker, *The Atlantic*, 9 April 2015.) Instant machine translation holds potential for small businesses in developing markets such as Latin America to engage in international commerce, but cross-cultural understanding remains important for building business relationships.

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. 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 re-running experiments as often as they like.
- Educators can play back videos of the experiments students have run online, and 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

- The National Service for Commercial Apprenticeship (SENAC) has funded 78 *carretas-escolas* (“school trucks”) equipped with a full technology suite. These mobile classrooms bring virtual training courses in IT and health to remote areas of Brazil: go.nmc.org/senac.
- A professor at Guanambi College has developed PharmaVP, a software tool for pharmacy students to practice clinical evaluation skills on virtual patients without risk of harm: go.nmc.org/virtrx.
- A project of EU Brazil Cloud Connect, the Leishmaniasis Virtual Laboratory provides a platform for disease researchers to share their latest data, collaborate with fellow scientists, and execute experiments that require large-scale computing power: go.nmc.org/brvl.

For Further Reading

Colleges See the Benefits of Remote Labs

go.nmc.org/rlab

(Steve Zurier, *EdTech Magazine: Focus on Higher Education*, 14 August 2014.) To reduce the startup costs of online laboratories, a group at Stanford University is developing software and database tools that will be available for free download.

Laboratory in the Sky? Why Cloud-Based Labs Are Replacing Conventional Ones

go.nmc.org/cblab

(Moran Shayovitch, *Data Center Knowledge*, 24 June 2015.) Virtual laboratories allow flexible access for students and provide educators with an oversight mechanism to monitor student progress and provide individualized assistance. Cloud-based platforms have no hardware to install, requiring less IT oversight and management.

Methodology

The process used to research and create the *2015 NMC Technology Outlook for Brazilian Universities* is very much rooted in the methods used throughout the NMC Horizon Project. All publications of the NMC 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 a nationally renowned panel of experts that first considers a broad set of trends, challenges, and important developments in technology, and then examines each of them in progressively more detail, reducing the set until the final listing of trends, challenges, and important developments in educational technology 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 *2015 NMC Technology Outlook for Brazilian Universities* can be found at brasil.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 expert panel. The panel 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 thought leaders have participated in the NMC Horizon Project Expert Panel; in any given year, a third of expert panel members are new, ensuring a flow of fresh perspectives each year.

Once the expert panel 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. Panel 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 expert panel 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 panel:

1. *Which of these important developments in technology will be most important to Brazilian universities within the next five years?*
2. *What important developments in educational technology are missing from our list? Consider these related questions:*
 - a. *What would you list among the established technologies that some Brazilian universities are using today that arguably ALL Brazilian universities should be using broadly to support or enhance teaching, learning, or creative inquiry?*
 - b. *What developments in technology that have a solid user base in consumer, entertainment, or other industries should Brazilian universities be actively looking for ways to apply?*

- c. *What are the developments in technology you see advancing to the point that Brazilian universities should begin to take notice during the next four to five years?*
3. *What key trends do you expect to accelerate the uptake of emerging technology across higher education in Brazil?*
4. *What do you see as the significant challenges impeding emerging technology uptake across Brazilian universities?*

One of the expert panel'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 expert panel moves to a unique consensus-building process based on an iterative Delphi-based methodology.

The responses to the research questions are systematically ranked and placed into adoption horizons by each panel 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 interim products behind the report, please visit the project wiki, which can be found at brasil.wiki.nmc.org.



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End Notes and Links

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