NMC Horizon Project

Technology Outlook

Brazilian Primary and Secondary Education 2012-2017

An NMC Horizon Project Regional Analysis

Technology Outlook for Brazilian Primary and Secondary Education 2012-2017

An NMC Horizon Project Regional Analysis

is a collaboration between

The New Media Consortium

and

Sistema FIRJAN

Sistema FIRJAN, the industry federation of the State of Rio de Janeiro, is a private, non-profit organization with approximately 10,000 member companies and 6,000 employees. Comprised of five organizations, SESI, SENAI, FIRJAN, CIRJ and IEL, Sistema FIRJAN is located in 22 cities across the state; its mission is to promote corporate competitiveness, education, and quality of life for workers and for the entire society, while contributing to the sustainable development of the State of Rio de Janeiro.

To accomplish its mission, Sistema FIRJAN focuses on corporate research and development, developing studies and research that give a technical foundation to its positions, guide companies and suggest policies, and contribute to the decision-making process.

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Technology Outlook for Brazilian Primary and Secondary Education 2012-2017

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Executive Summary

The *Technology Outlook for Brazilian Primary and Secondary Education 2012-2017: An NMC Horizon Project Regional Analysis* reflects a collaborative research effort between the New Media Consortium (NMC) and Sistema FIRJAN to help inform Brazilian educational leaders about significant developments in technologies supporting teaching, learning, and creative inquiry in primary and secondary education.

All of the primary 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 Brazilian primary and secondary education over the next five years. The same process underlies the well-known *NMC Horizon Report* series (#NMCHz), which is the most visible product of the Horizon Project, an on-going research effort that commenced a decade ago to systematically identify and describe emerging technologies likely to have a large impact on education around the globe.

For the *Technology Outlook for Brazilian Primary and Secondary Education 2012-2017,* in an effort that ran from August through October 2012, a carefully selected group of 30 experts considered hundreds of relevant articles, news clippings, blog posts, studies, and project examples as part of the preparation that ultimately pinpointed the most notable emerging technology topics, trends, and challenges for schools in Brazil over the next five years.

Known as the 2012 Horizon Project Brazil Advisory Board, this group of experts was composed of knowledgeable individuals, all highly regarded in their fields, and representing a range of diverse perspectives across the primary and secondary education sectors. Adhering to the philosophy of open content, the advisory board's research, discussions and ranking procedures can be viewed by anyone at brasil.wiki.nmc.org. The Delphi-based research methodology is explained in further detail in a special section located at the end of this report.

The 12 "Technologies to Watch" presented in the body of this report reflect our experts' opinions about which of the nearly 50 technologies considered will be most important to Brazilian primary and secondary education over the next five years. As the table below illustrates, the choices of the Brazil Advisory Board overlap in interesting ways with the selections made by experts who contributed to the globally focused *NMC Horizon Report > 2012 Primary and Secondary Edition* and the *Technology Outlook for Iberoamerican Tertiary Education 2012-2017*, which examined technologies in tertiary education in Latin America.

All three of these projects' advisory boards — a group of 121 acknowledged experts — agree that collaborative environments and components of mobile phones will likely tip into mainstream use within the next year, a trend that spans all of education across much of the world. On the far-term horizon, the three advisory boards foresee semantic applications as growing in relevance and use within four to five years in education.

There are some interesting overlaps between the opinions of our Brazilian primary and secondary experts and the globally focused school experts whose contributions were published in June 2012. As mentioned above, collaborative environments was on the near-term horizon for both reports, reflecting a consensus that online learning and workspaces are entering mainstream use in schools. Collaboration is increasingly perceived as a fundamental skill worldwide, which has sparked a growing demand that students, teachers, and schools find creative ways to develop those skills within learning activities.

Mobile phones and tablets were on the near-term horizon for all three groups, reflecting the mounting interest in these devices across primary and secondary education.

Comparison of "Short List" Topics Across Three NMC Horizon Research Projects

Technology Outlook Brazilian Primary and Secondary Education 2012-2017	Technology Outlook Iberoamerican Tertiary Education 2012-2017	NMC Horizon Report 2012 K-12 Edition
Time-to-Adoption Horizon: One Year or Less		
Collaborative Environments	Cloud Computing	Cloud Computing
Game-Based Learning	Collaborative Environments	Collaborative Environments
Mobile Phones	Mobile Apps	Mobiles and Apps
Tablet Computing	Open Content	Tablet Computing
Time-to-Adoption Horizon: Two to Three Years		
Cellular Networks	Game-Based Learning	Digital Identity
Geolocation	Geolocation	Game-Based Learning
Mobile Apps	Personal Learning Environments	Learning Analytics
Open Content	Tablet Computing	Personal Learning Environments
Time-to-Adoption Horizon: Four to Five Years		
Collective Intelligence	Augmented Reality	Augmented Reality
Mobile Laboratories	Learning Analytics	Natural User Interfaces
Personal Learning Environments	Massively Open Online Courses	Semantic Applications
Semantic Applications	Semantic Applications	Assessment of 21st Century Skills

There were a number of distinct choices made by the Brazilian experts — more so than any other advisory board in the past — not only underlying their views about technology, but adoption timeframes as well. While both the global and Iberoamerican advisory boards saw mobile apps poised for adoption within a year, the Brazilian advisory board believed they were two to three years away.

This disparity in time frame reflects an ongoing issue that is not unique to Brazil; access to broadband Internet is not yet pervasive, especially outside urban areas. While much of Brazil's population owns a smartphone, the infrastructure to support web browsing, social networking, and beyond is insufficient. Cellular broadband networks are seen as the fastest, most efficient way to achieve adequate levels of broadband penetration across much of the country.

In this regard, substantial advances in infrastructure are anticipated due to the placement of both the next World Cup and the next Summer Olympics in Brazil, and these events, to be held in 2014 and 2016, respectively, are important context in interpreting these findings. Mobile phones and tablet computing devices are in the near-term, while network-dependent extensions of those devices are further away from widespread adoption. Notably, cloud computing, a group of technologies clearly dependent on broadband to be used effectively, is placed in the near-term in the comparison reports, yet did not make the list this year in Brazil at all.

In other ways, however, Brazil is ahead of the curve. While both the global K-12 and Iberoamerican advisory boards were in agreement that integrating games into education was two to three years away — and have been for some time — the Brazilian experts were the first Horizon Project advisory board to see games on the near-term horizon. The Brazilian advisory board views games and gaming consoles as a natural bridge between students and information, and incorporating gaming mechanics into learning has proven to improve logic, reasoning, and other important skills. Though there are not many prominent examples of educational or serious games in Brazil, especially Portuguese-based games, there are a growing number of organizations and groups that are exploring opportunities for developing games specifically for schools.

Just as the nuances of the technologies and their associated adoption horizons featured in this report are specific to Brazilian primary and secondary education, even if there are commonalities

with other reports, the trends and challenges selected by the Brazilian advisory board distinctly reflect the current drivers and obstacles facing schools in Brazil over the coming five years. The experts spent a fair amount of time researching and discussing relevant trends and challenges in the context of Brazilian primary and secondary teaching, learning, and creative inquiry. A full discussion of trends and challenges identified by the advisory board begins on page 18; the top three from those longer lists are included in the tables in this section.

Top Ranked Trends Across Three NMC Horizon Research Projects

Technology Outlook Brazilian Primary and Secondary Education 2012-2017	Technology Outlook Iberoamerican Tertiary Education 2012-2017	NMC Horizon Report 2012 K-12 Edition
Education paradigms are shifting to include online learning, hybrid learning and collaborative models.	People expect to be able to work, learn, and study whenever and wherever they want.	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.	The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators.	The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators.
People expect to be able to work, learn, and study whenever and wherever they want.	Changes in university education have caused most universities to prioritize the training of teachers to improve the quality of teaching.	As the cost of technology drops and school districts revise and open up their access policies, it is becoming increasingly common for students to bring their own mobile devices.

The 30 advisory board members in this project agreed with the global advisory board as to the most important trend; they saw doors opening in Brazilian primary and secondary schools to more online, hybrid, and collaborative learning models. These emerging models foster teamwork, communication and informal and peer-to-peer leaning. Just as the advisory board believed the ways in which students learn are changing, the experts also acknowledged the evolving role of teachers. With a constantly expanding universe of online resources at their fingertips, the expectations of students are driving much of the realization that change is both needed and coming.

Among the top trends was also the expectation that people should be able to work, learn, and study from wherever they want. This notion very much depends on mobile technologies and also reflects their prominence in the report because devices such as smartphones and tablets enable users to access and share information on the go.

Horizon Project advisory boards in general have agreed that trends like these (and the others listed on page 18 are clear drivers of technology adoption; the Brazil group especially saw such a linkage. At the same time, these panels of experts also agree that technology adoption can be and often is hindered by challenges both local and systemic. 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, and that was especially true in this case. The challenges identified by this advisory board clearly reflect local imperatives, and uniquely portray the current state of technology adoption in Brazilian primary and secondary schools.

The need to improve teacher training, for example, continues to dominate conversations in Brazil about improving learning experiences in primary and secondary education; there is a common

recognition that merely placing technology in schools is not adequate, but that pre-service teachers must be digitally literate and be able to produce and manage media before they enter the classroom. Similarly, in-service teachers must engage in ongoing professional development to learn new skills as technology evolves. It has become clear that while there is a great deal of innovation taking place within the educational technology industry, the potential to affect learners is stunted because teachers must be trained in order to leverage new tools effectively.

Top Ranked Challenges Across Three NMC Horizon Research Projects

Technology Outlook Brazilian Primary and Secondary Education 2012-2017	Technology Outlook Iberoamerican Tertiary Education 2012-2017	NMC Horizon Report 2012 K-12 Edition
Teacher training should be modified to adapt to new students and new technologies.	We need to transform the structure of institutions to match models of the knowledge society and not of post-industrial society.	Digital media literacy continues its rise in importance as a key skill in every discipline and profession.
Using technology is not enough; it is also necessary to change the educational and teaching methodologies.	Most academics are not using new and compelling technologies for learning and teaching, nor for organizing their own research.	K-12 must address the increased blending of formal and informal learning.
The educational curriculum needs reinvention.	Digital literacy continues its rise in importance as a key skill in every discipline and profession.	The demand for personalized learning is not adequately supported by current technology or practices.

Discussions about the need to shift to more student-centered pedagogies were prominent throughout the project; the main challenge the experts saw was the need for teaching methodologies to connect with how students learn naturally. This newly conceived approach would be challenging because traditional teacher-centered classrooms and lectures remain the norm in Brazilian schools.

Beyond classroom approaches, the advisory board agreed that the core curriculum itself is in need of transformation. There was a consensus among the experts that students benefit from learning material and working on assignments that have concrete applications to their lives, and especially those that can involve them in solving community-based problems that they know need attention.

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 Brazilian schools over the next year, two to three years, and four to five years. Each of these pages opens with a carefully crafted definition of the highlighted technology, outlines its educational relevance, points to several real life examples of its current use in schools, and ends with a short list of additional readings for those who wish to learn more. Following those discussions are sections that detail the Brazilian advisory board's ten top-most 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 in Brazilian primary and secondary education. 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 report is presented.

Time-to-Adoption: One Year or Less

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 commonplace as strategies 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 and Learning in Brazilian Primary and Secondary Education

- A class or project group can easily assemble a collaborative workspace very quickly using free tools like Google Apps, wikis, blog software, or social networking sites.
- Collaborative environments make it simple to capture the exchange of ideas, to develop or refine presentations or documents — and to ensure all voices are heard in the process.
- Large-scale collaborative environments can facilitate the development of learning communities among students or teachers who share similar interests.
- Students and teachers from different schools — and even different countries — can exchange ideas or questions and research a topic whenever it is convenient for them.

Collaborative Environments in Practice

- In the First Peoples' Project, children on five continents have used technology to share their respective cultures in a digital cultural exchange: go.nmc.org/zytbi.
- The international eLanguages project enables teachers to select projects for their classes and exchange ideas with other teachers across the world: go.nmc.org/gsgvm.
- The Flat Classroom Project joins K-12 students to collaborate virtually on assignments with real world relevance: go.nmc.org/psoan.
- Portal do Professor is an initiative from the Brazilian Ministry of Education and the Ministry of Science and Technology to provide teachers with collaboration tools: go.nmc.org/xpjcg.

For Further Reading

Collaborative Learning Environments Sourcebook
go.nmc.org/bkjvl

(CriticalMethods.org; accessed 3 September 2012.) This online book describes and provides links to a wide variety of collaboration resources and tools.

Learning Reimagined: Participatory, Peer, Global, Online
go.nmc.org/xshrq

(Howard Rheingold, *DMLCentral*, 22 July 2011.) This article addresses how open educational resources influence the pedagogy behind peer learning groups.

Using Collaborative Virtual Environments As Project Support Work in High School and Elementary School
go.nmc.org/tnrwq

(João Guilherme Rolim, Servico Nacional de Aprendizagem Comercial, 2011.) This Portuguese study examines collaborative environments for work projects and literacy practices in high school and elementary school.

Time-to-Adoption: One Year or Less

Game-Based Learning

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

Relevance for Teaching and Learning in Brazilian Primary and Secondary Education

- Educational games can be used to teach cross-curricular concepts that touch on many subjects in an engaging way.
- Games offer opportunities for both discovery-based and goal-oriented learning, and can be very effective ways to develop teambuilding skills.
- Many students are already familiar with the structure of games because they play them outside of school, making it easier for teachers to integrate them into the classroom.
- Simulations and role-playing games function as parallels to real world problems and promote hands-on learning.

Game-Based Learning in Practice

- Communidades Virtuais is a Brazilian organization that develops digital games for specific learning scenarios that are often distributed for free: go.nmc.org/aozcd.
- Created by the Oi Futuro Institute in Recife, Brazil, the NAVE researches new educational methodologies, such as teaching K-12 students game design: go.nmc.org/ftzaf.
- Games for Change is a Brazilian organization that promotes events, competitions, and projects that merge games, education, technology, and social change: go.nmc.org/cmnft.
- In the Gameficacao de Sorocaba project, 8th grade students at the School of Municipal Achilles Almeida produced four geography games: go.nmc.org/bimcy.

For Further Reading

The 50 Best Videos For Teachers Interested In Gamification
go.nmc.org/jvxny

(Jeff Dunn, *Edudemic*, 12 September 2012.) These 50 videos share what experts, teachers, and students think about learning through gamification and gaming.

Overcoming Barriers to Educational Serious Games Adoption in Brazil
go.nmc.org/ppihb

(Eliane Alhadeff, *Serious Games* Market, 6 March 2011.) Brazil lacks companies that produce simulation-based games, despite the growing amount of evidence that Brazilian students perform better when learning through these types of games.

Where Do Educational Games Come From?
go.nmc.org/nrfkd

(Frank Catalano, *MindShift*, 19 September 2012.) Educational games are now being developed by a variety of sources, from non-profits to educational institutions, and new start-ups. This article describes how this market has come to be.

Time-to-Adoption: One Year or Less

Mobile Phones

Mobile phones as a category have proven more interesting and more capable with each passing year. The mobile market today has more than 6 billion subscribers, more than two-thirds of whom live in developing countries. Well over a billion new phones are produced each year, a flow of continuous enhancement and innovation that is unprecedented in modern times. The fastest-growing sales segment belongs to smartphones — which means that a massive and increasing number of people all over the world now own and use a computer that fits in their hand and are able to connect to the network wirelessly from virtually anywhere. Ericsson predicts that by 2015, 80% of people accessing the Internet worldwide will be doing so from a mobile device. In developed countries — and increasingly in the rest of the world as well — it is quite common for young people to carry their own mobile devices. The unprecedented evolution of these devices continues to generate great interest, and their increasing capabilities make them more useful with each new generation of devices. The ability to run third-party applications represents a fundamental change in the way we regard mobiles and opens the door to myriad uses for learning. Brazil is one of the world's largest mobile markets, with 130 devices for every 100 inhabitants, making mobiles a natural choice for enhancing education.

Relevance for Teaching and Learning in Brazilian Primary and Secondary Education

- Mobiles are where many technologies have converged, including geolocation, text, still and video photography, sensors, and of course, cellular telephones, making even the most basic of these devices very adaptable to learning.
- The basic audio and video tools embedded in most mobiles provide excellent avenues through which to personalize language learning.
- The portability and Internet-capability of most mobile devices makes them ideal portals and storehouses of reference materials and learning experiences, as well as general-use tools for fieldwork.

Mobile Phones in Practice

- The Global Enterprise Mobile Alliance is a coalition of seven MMS providers who are working together to make BYOD a reality for Brazilian students: go.nmc.org/vcxdl.
- Kantoo's Vivo is a language-learning SMS service in Brazil that enables students to learn on the go: go.nmc.org/duqvi.
- Mobile Education Lab is a creative organization that promotes the discovery and invention of digital content that explores the potential of mobile technologies: go.nmc.org/erhcb.
- Several Brazilian cellular phone carriers have launched mobile language courses, including Claro and Vivo: go.nmc.org/qchfd and go.nmc.org/afsdf.

For Further Reading

4 Reasons Why Brazil Is The Next Hot Mobile Market
go.nmc.org/klioc

(Eric Savitz, *Forbes*, 1 August 2012.) This article discusses the imminent mobile boom in Brazil, citing growing cellular networks among the reasons.

Surveying Mobile Learning Around the World
go.nmc.org/afnxs

(Carla Jiminez Iglesias; James Liu, World Bank, 29 May 2012.) Two papers in this series focus on m-learning in Latin America, and provide recommendations on how to improve it.

Time-to-Adoption: One Year or Less

Tablet Computing

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

Relevance for Teaching and Learning in Brazilian Primary and Secondary Education

- Because of their mobility, tablets are great tools for field activities that are difficult to do with netbooks and notebooks. They can record videos, take photographs, and much more.
- Tablets are easily adaptable to almost any learning environment, with tens of thousands of educational applications available — although most are in English.
- Users interact intuitively with tablets via touchscreens, allowing teachers and learners to concentrate more on the activity than the technology.

Tablet Computing in Practice

- The I-slate is a low-cost tablet device that is designed for classrooms that lack electricity: go.nmc.org/lrpkz.
- In the Colegio Objetivo project, students use tablets for language and writing classes, as well as using the tablet's cameras to illustrate geometry concepts: go.nmc.org/evmzz.
- Teachers at Clay Community Schools in Brazil are receiving 300 iPad devices to improve mobile learning under their three-year technology plan: go.nmc.org/zcmgs.

For Further Reading

Apple Gets Tax Incentives in Brazil to begin iPad Production
go.nmc.org/mlvdg

(Joe Aimonetti, *CNET*, 25 January 2012.) If Apple sets up iPad production in Brazil, tax incentives will significantly decrease cost of the device, making it easier to integrate in schools.

The Brazilian Tablet Fever
go.nmc.org/rarby

(Karolina Puin, *The Brazil Business*, 2 October 2012.) The Brazilian government plans to fund an initiative to distribute more tablets to public schools.

Education in the Post-PC Era
go.nmc.org/xysow

(Bevil Wooding, *The Guardian*, 19 April 2012.) With intuitive interfaces and the ability to leverage cloud-based apps, tablets have become ideal educational tools.

Tablets Account for Nearly 40 Percent of Non-Computer Web Traffic in Brazil and Colombia
go.nmc.org/hhnmn

(comScore, 22 December 2011.) A 2011 report by comScore detailed how in Brazil the highest share of non-computer traffic came from tablets.

Time-to-Adoption: Two to Three Years

Cellular Networks

The boundaries between cellular networks and the Internet are blurring. Increasingly, and more so in the developing world, the "on ramp" to the Internet is a mobile device accessing the Internet via a cellular network that extends significantly beyond even the electric grid. As the network expands, mobiles are the access point of choice for information of all kinds, common tools and communications, training materials, and more. Because they are always connected, many people see mobile computing platforms as their device of choice, and more affordable, more accessible, and easier to use than desktop computers. Mobile devices are becoming more and more pervasive, underscoring the need for a solid mobile broadband infrastruture. As part of its commitments for the upcoming World Cup in 2014 and the Summer Olympic Games in 2016, Brazil is expanding its 3G networks, and rolling out 4G and LTE as well. According to Teleco, by December 2013, it is expected that all World Cup hosting cities in Brazil will have 4G, and by May 2014, most state capitals and municipalities with more than 500,000 people will have it, significantly expanding Internet access in Brazil.

Relevance for Teaching and Learning in Brazilian Primary and Secondary Education

- As faster cellular networks come online, the greater bandwidth will enable more complex applications, more use of video, and even cloud services to be delivered to mobile devices.
- Additional network capacity will help Brazilian schools to leapfrog more traditional forms of technology, and to move directly to mobile learning and the mobile Internet.
- In a country as large as Brazil, mobile networks may be the most efficient way to solve two needs at once for rural Brazilian communities — access to cheap and easy communications, as well as access to the Internet and all that implies.

Cellular Networks in Practice

- WorldGSM is a solar powered broadband network being developed in Nigeria that has been designed to serve rural populations in developing economies. The network draws no power from the electricity grid: go.nmc.org/zxjzv.
- To prepare for the crowds at the upcoming World Cup, Brazil has assigned 4G cellular frequencies to four wireless carriers who have agreed to expand the network infrastructure to take advantage of them: go.nmc.org/gsghs.
- A high school history teacher uses Poll Everywhere, which leverages cellular networks, to allow students to respond via text message to questions: go.nmc.org/qvvox.

For Further Reading

Connected Brazil (PDF)
go.nmc.org/ksiav

(Beñat Bilbao-Osorio and Soumitra Dutta, p. 75, *The Global Information Technology Report 2012*, World Economic Forum and INSEAD, 2012.) In this report, the telecommunications industry of Brazil is highlighted as a successful model for private-public collaboration.

Future Mobile Networks (PDF)
go.nmc.org/iirzd

(Informa Telecoms & Media, Intelligence Centre, 9 February 2011.) Analysts at Informa discuss strategies for evolving mobile networks. As a part of their research, they report on their findings from the LTE Latin America Summit in Rio de Janeiro.

Mobile Revolution Brings Mixed Benefits to Brazil
go.nmc.org/irngo

(Naomi Canton, CNN, 19 October 2012.) The World Bank predicts that by 2015 50% of Brazil will own smartphones, but the impact is contingent upon the development of adequate cellular networks.

Time-to-Adoption: Two to Three Years

Geolocation

Everything on the Earth's surface has a location that can be expressed with just two coordinates. Using new classes of geolocation tools, it is very easy to determine and capture the exact location of physical objects — and even to capture the exact locations where photographs and video are taken. It is also becoming easier to work with geolocation data: it can be plotted on maps; combined with data about other events, objects, or people; graphed; charted; or manipulated in myriad ways. Indeed, such data are leading to entirely new forms of mapping. Our devices increasingly have the ability to know where they are (and, consequently, where we are), and to routinely record our coordinates as we take photographs, talk to friends, or post updates to social networking websites. The transparency of this group of technologies —increasingly embedded in all sorts of devices — is making them very much an essential part of our lives. Recent advancements in mobile apps leverage geolocation so that users may learn more about a site they are visiting, or discover other people or places in their vicinity, making the areas surrounding them new and dynamic spaces for learning.

Relevance for Teaching and Learning in Brazilian Primary and Secondary Education

- Apps using geolocation (e.g. Nru and Wikitude) provide students with information about their surroundings and details about nearby cultural sites.
- Effective for learning outside the classroom, geolocation enables immersive activities including collective mapping, scavenger hunts, and field trips.
- Geolocation aids students when they need to work with geographical references and historical data. Tools such as Google Earth and Open Street Maps contribute to geographical knowledge and support social projects and collaborative learning.
- When geolocation is integrated with social media and networks, it can be employed to suggest places nearby that students can visit to learn more about a specific subject.

Geolocation in Practice

- Earlier this year, researchers at the Federal University of Paraná announced the opening of the Open Source Geospatial Lab, an event that follows an international initiative of establishing hubs to disseminate geospatial technology: go.nmc.org/atxmv.
- Students at Genesis Academy High School are generating maps and keying in data layers that reflect immunization rates down to the county level: go.nmc.org/rhado.
- Working alongside several scientific institutions, UNICEF developed the Rio Youth Mapping Project, a mapping platform that is being used for research by students from lower income communities in Brazil: go.nmc.org/zjuvh.

For Further Reading

Mobile GPS for Indoor Use: Just Around the Corner?
go.nmc.org/zeydv

(Canadian Heritage Information Network, 1 October 2012.) Advancements in GPS that pinpoint a user's location based on magnetic fields may make indoor GPS a reality soon.

Why Location-Based Gaming Is The Next Killer App
go.nmc.org/mqbtf

(Greg Steen, *Mashable*, 24 July 2011.) Geolocation is beginning to converge with two other educational technologies: games and mobile apps. Gaming apps with geolocation integrated allows for users to engage with other players in their communities and even incorporate local businesses into the narrative of the game.

Time-to-Adoption: Two to Three Years

Mobile Apps

There is a revolution that is taking place in software development that parallels the changes in recent years in the music, publishing, and retail industries. Mass market is giving way to niche market, and with it, the era of highly priced large suites of integrated software is giving way to a new view of what software should be. Smartphones such as the Galaxy, iPhone, and Android have redefined what we mean by mobile computing, and the small, often simple, low-cost software extensions to these devices — apps — have become a hotbed of development. New tools are free or sell for as little as 99 cents, making it easier for people to develop apps. A popular app can see millions of downloads in a very short time, and that potential market has spawned a flood of creativity that is instantly apparent in the extensive collections available in the app stores. These retail phenomena provide an easy, fast, and totally new way to deliver software that reduces distribution and marketing costs significantly. Apple's app store opened in July 2008; Google's followed in October of that year. By July 2012, more than 50 billion apps had been sold or downloaded; simple but useful apps have found their way into almost every form of human endeavor. Mobile apps are particularly useful in education as they enable students to learn and experience new concepts wherever they are, often across multiple devices. While mobile apps are gaining traction for education in Brazil, app development is lagging because of the current lack of political and fiscal structures that could allow mobile devices to be more affordable.

Relevance for Teaching and Learning in Brazilian Primary and Secondary Education

- 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, drawings, videos, and more.
- Augmented reality apps allow users to visit cultural sites and view their history (i.e. what the landmarks looked like during different time periods) through their mobile.
- Scientific and mathematics apps use the cameras, microphones, and sensors in most mobiles to make it easy to extend learning outside the classroom. Creative apps help students create videos and interactive media, record interviews, or compose music clips and soundtracks.

Mobile Apps in Practice

- Mobile Brain develops mobile apps that help Brazilian students prepare for the ENEM exam: go.nmc.org/rjqkq.
- The National Academy Foundation and Lenovo launched a competition challenging high school students to develop Android-based mobile apps. Students developed business plans and apps: go.nmc.org/xezrz.
- Qranio is a free Portugese app in which users earn virtual currency for completing learning tasks: go.nmc.org/vvncs.

For Further Reading

5 Videos to Inspire Mobile Content Creation in the Classroom
go.nmc.org/ykasr

(Jennifer Funk, *edcetera*, 17 October 2012.) This article highlights five inspiring examples of content that can be created by leveraging mobile apps.

How Mobile Apps Are Changing Classrooms and Education
go.nmc.org/howmo

(Piyush Mangukiya, *Huffington Post*, 3 February 2012.) Mobile apps are adding to the in-classroom experience as well as extending the classroom outside of the building.

Time-to-Adoption: Two to Three Years

Open Content

The movement toward open content reflects a growing shift in the way academics in many parts of the world are conceptualizing education to a view that is more about the process of learning than the information conveyed in their courses. Information is everywhere; the challenge is to make effective use of it. Open content embraces 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 also a response to the rising costs of traditionally published resources and the lack of educational resources in some regions. As customizable educational content — and insights about how to teach and learn with it — is increasingly made available for free over the Internet, students are learning not only the material, but also skills related to finding, evaluating, interpreting, and repurposing the resources in partnership with their teachers. Though most open content projects are taking place at universities, schools benefit from the resources. In Brazil, major barriers to adoption are access to open content, exacerbated by the lack of broadband, and the paucity of resources written in Portuguese.

Relevance for Teaching and Learning in Brazilian Primary and Secondary Education

- Open, sharable materials reduce teacher workloads as open educational resources do not need to be recreated 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 University of São Paulo has created an open repository of history lessons that are prepared by students as a final course assignment: go.nmc.org/jdvjj.
- The Open High School of Utah relies on open content for its instructional subject matter and is often cited as a successful model for the use of open educational resources: go.nmc.org/wesdn.
- Dante Alighieri High School's REA Project (São Paulo) provides selected open educational materials created by students and teachers: go.nmc.org/xeqdc.

For Further Reading

Open Educational Resources in Brazil: State-of-the-Art, Challenges and Prospects for Development and Innovation (PDF)
go.nmc.org/krari

(Andreia Inamorato dos Santos, UNESCO, 2011.) UNESCO's report discusses OERs in Brazil looking at national policy and other influencers, and offers recommendations.

Open Educational Resources and Distance Learning in Brazil
go.nmc.org/mizxr

(Luciano Sathler, *Educational Technology Debate*, February 2012.) Research shows major growth in distance learning enrollment in Brazil, thus creating a demand for better OERs.

Open Resources: Transforming the Way Knowledge Is Spread
go.nmc.org/openre

(D. D. Guttenplan, *The New York Times*, 18 March 2012.) This article examines the state of open content in education. The authors see open content as vital to extending literacy and opportunity while cutting costs for schools, families, and students worldwide.

Time-to-Adoption: Four to Five Years

Collective Intelligence

Collective intelligence is a term for the knowledge embedded within societies or large groups of individuals. It can be explicit, in the form of knowledge gathered and recorded by many people; or it can be tacit or implicit, referring to the intelligence that results from the data generated by the activities of many people over time. New and vast information stores are being created in real-time by thousands of people in the course of their daily activities, some explicitly collaborating to create collective knowledge stores, some contributing implicitly through the patterns of their choices and actions. The data in these new information stores has come to be called collective intelligence, and both forms have already proven to be compelling applications of the network. Explicit knowledge stores, such as Wikipedia, refine knowledge through the contributions of thousands of authors; implicit stores allow the discovery of entirely new knowledge by capturing trillions of key clicks and decisions as people use the network in the course of their everyday lives. Google uses tacit data to continuously refine its search and ad results. Discovering and harnessing the intelligence in such data — revealed through analyses of patterns, correlations, and flows — is enabling more accurate predictions about people's preferences and behaviors, and helping users understand and map relationships, and gauge the relative significance of ideas and events.

Relevance for Teaching and Learning in Brazilian Primary and Secondary Education

- Collective intelligence promotes peer-to-peer learning through knowledge networks that grow by the minute as people share the information they have gained in specific disciplines and fields.
- Implicit knowledge stores provide insight on the learning choices we make by tracking our online searches and activity, and ultimately direct us to the discovery of new information.
- Knowledge networks such as Wikipedia encompass multiple points of view and allow people to make instant updates to research and topics, unlike in printed textbooks by a single author.

Collective Intelligence in Practice

- City of Knowledge is a Brazil-based research project that examines the democratization of knowledge creation networks: go.nmc.org/zssgx.
- The Khan Academy is a vast but highly curated collection of videos that supplement school curriculum: go.nmc.org/jlwbj.
- Piloting the Wikipedia Education Program in Brazil, Dr. Edivaldo Moura Santas required his students to contribute physics articles on the Portuguese Wikipedia: go.nmc.org/ppluw.

For Further Reading

Crowd Computing and Human Computation Algorithms at Collective Intelligence (Video)
go.nmc.org/yptvv

(Rob Miller, 2012 Collective Intelligence Conference.) In a National Science Foundation event, a researcher explores the infrastructures of collective intelligence.

Interview with Pierre Lévy on Collective Intelligence Literacy
go.nmc.org/smzwz

(Pierre Lévy, *Flat Classroom*, 20 October 2011.) A media scholar discusses the skills and philosophies people need to contribute to collective intelligence.

Wikis for Participatory Learning (PDF)
go.nmc.org/fhwgv

(Kiruthinka Ragupathi, *Technology in Pedagogy, No. 5*, September 2011.) The author explores the integration of wikis into the classroom as a means of fostering participatory and peer-to-peer learning.

Time-to-Adoption: Four to Five Years

Mobile Laboratories

The growth of mobile technologies and telecommunications networks has given rise to a new type of laboratories — mobile laboratories that fit into the palm of a hand and easily go wherever they are needed. The capabilities of the latest mobile devices enable users to perform science experiments, track environmental changes, record data, and much more on the go. Furnished with sensors, actuators, accelerometers, and other features, smartphones suddenly make cumbersome laboratory equipment extremely portable. Mobile apps make use of these hardware components, and extend their capabilities in ways that allow educators and scientists to reimagine field equipment. The ability to both capture data in the field and support the processing of those data and related information through mobile and Internet applications opens up the world outside the classroom as an endless learning space. Mobile laboratories can be used to extend access to more traditional forms of remote laboratories, and enable quick answers without the need to leave a remote site; users can run sophisticated experiments from their mobile devices, operating the lab equipment remotely via their mobile device. While mobile laboratories have much potential to extend learning outside the classroom, this technology is still in a conceptual phase. Research into mobile laboratory developments and projects does not currently yield many concrete examples of the idea in practice, but given the depth of scientific and related apps available for mobiles, the concept offers considerable promise.

Relevance for Teaching and Learning in Brazilian Primary and Secondary Education

- Smartphone sensors and information stores make it possible for school science departments to monitor or share the status and history of artifacts in their collections of specimens from anywhere to anyone with an Internet connection.
- Students can use their mobile devices to collect environmental data; for example, the DataAnalysis and Mobile Grid iPad apps allow users to input observations and create data visualizations on the spot.
- Video apps, such as Magisto and Reel Director, make it easier for learners to record and edit videos on the go, and share them instantly with their peers and teachers.

Mobile Laboratories in Practice

- Cosm is a platform that connects devices and apps so they can store and exchange data, track device state and location, add alerts and notifications, and review historical activity: go.nmc.org/kzhep.
- MIT's Amarino is a toolkit that allows smartphone users to control the lights in a room and detect exposure levels to potentially harmful environmental factors: go.nmc.org/uyllx.
- The University of New South Wales created the Rubrik app to help them collect real-time data over the network in a robotics design project competition: go.nmc.org/rubrik.

For Further Reading

The Internet Gets Physical
go.nmc.org/yirhc

(Steve Lohr, *The New York Times*, 17 December 2011.) Via new ways of transmitting data made possible by the "Internet of Things," humans are linking to their environment in ways that can benefit energy conservation, health care, and more.

The Scientist and the Smartphone
go.nmc.org/qcveb

(*Nature Methods*, 2010.) Advancements in smartphone technology are enabling more and more scientists to use their mobiles for laboratory work.

Time-to-Adoption: Four to Five Years

Personal Learning Environments

The term personal learning environments (PLEs) is loosely defined, but is generally used to describe tools that support self-directed and group-based learning, focus on individual learning goals and needs, and have great capacity for flexibility and customization. The term has been evolving for some time, but has crystalized recently around the personal collections of tools and resources a person assembles to support their own learning — both formal and informal. The conceptual basis for PLEs has shifted significantly in the last two years, as smartphones, tablets, and apps have begun to emerge as compelling alternatives to browser-based PLEs and e-portfolios. There has been a corresponding move away from centralized, server-based solutions to distributed and portable ones. Using a growing set of free and simple tools and applications, or even a personally assembled collection of apps on a tablet, it is already easy to support one's ongoing social, professional, and learning activities with a handy collection of resources and tools that are always with you. While the concept of PLEs is still fairly fluid, it is clear that a PLE is not simply a technology but an approach or process that is individualized by design, and thus different from person to person.

Relevance for Teaching and Learning in Brazilian Primary and Secondary Education

- The notion of a PLE is a useful way for students to think about the collections of apps they might assemble on a smartphone or tablet to help them support their learning and learning-related work.
- PLEs may cater to students with differing learning styles; for instance, visual learners might be able to obtain material from a different source than auditory learners do.
- Students using PLEs may benefit from the practice of keeping track of, and curating, their own resource collections.

Personal Learning Environments in Practice

- A former teacher is creating an open cloud service that leverages crowd sourced tagging to share and organise educational content, such as e-books, videos, and apps, into customizable learning maps: go.nmc.org/genome.
- "Innovative Technologies for an Engaging Classroom" is a pan-European project that joins policy-makers with educators to develop scalable learning environments: go.nmc.org/itec.
- Waukesha STEM Academy uses personalized and blended learning strategies to empower students to take ownership of their learning style and pace: go.nmc.org/socyf.

For Further Reading

Differentiate, Individualize, and Personalize Instruction
go.nmc.org/xhulq

(Patricia Gomes, *Porvir*, 22 August 2012.) A Brazilian writer discusses the meaning of personalization and how a student's knowledge can be assessed at an individual level.

Role of Teacher in Personal Learning Environments
go.nmc.org/blkyk

(Zaffar Ahmed Shaikh and Shakeel Ahmed Khoja, *Digital Education Review, No. 21*, 2012.) This paper describes how a teacher's role has been transformed as personal learning environments and social learning technologies gain traction.

This Time It's Personal
go.nmc.org/person

(Jennifer Demski, *The Journal*, 4 January 2012.) This article emphasizes the crucial role of changing the current classroom infrastructure to make it more student-centered, and to incorporate technology in a transformative way.

Time-to-Adoption: Four to Five Years

Semantic Applications

Semantic-aware applications infer the meaning, or semantics, of information on the Internet to make connections and provide answers that would otherwise be elusive or altogether invisible. New applications use the context of information as well as the content to make determinations about relationships between bits of data; examples such as TripIt, SemaPlorer, and Xobni organize information about travel plans, places, or email contacts and display it in convenient formats based on semantic connections. Semantic searching is being applied to scientific inquiries, allowing researchers to find relevant information without having to deal with apparently similar, but irrelevant, information. Semantic applications have the potential to be immensely powerful educational resources that enable students to more effectively sift, query, and gather relevant information. Semantic applications also have applications in the fields of data mining and learning analytics.

Relevance for Teaching and Learning in Brazilian Primary and Secondary Education

- As the amount of available information continues to grow, tools that can deliver context-sensitive information will become more key for scholarship, research, and sense-making.
- Even today, common search tools are able to return results from a topical search with video, images, text, and other content aggregated and presented in a variety of ways that reveal patterns in the results. Fully-developed semantic search tools will refine search results in ways that reveal the subtle relationships and distinctions among them.
- Semantic portals that intelligently aggregate information from a variety of sources would facilitate learning in many practical and useful ways.

Semantic Applications in Practice

- InstaGrok is a new search engine built specifically for educational use. Typing in a search term pulls up formatted interactive results as well as quiz questions to test your knowledge: go.nmc.org/czyrw.
- The NeOn project is an open-source endeavour investigating the life cycle of the network ontologies that enable semantic applications: go.nmc.org/zbyzh.
- NextBio is a repository of public and private genomic data, up-to-date reference genomes, and clinical trial results. Academic researchers can use the search tools for free, which also allows data correlation and meta-analysis: go.nmc.org/vuwss.
- Through the Semantic Cloud Services Framework project, University of Maryland, Baltimore County aims to create a search engine for cloud services. The prototype would allow users to select service options, security settings, and compliance requirements: go.nmc.org/giapb.

For Further Reading

How Google Organizes the World
go.nmc.org/laolz

(Jon Mitchell, *Read Write Web*, 26 July 2012.) This article describes how Google is moving away from keyword matching toward recognizing real-world objects and information and their relationships.

Yves Raimond on the BBC's Interlinked, Semantic Web of the Future
go.nmc.org/mkwgg

(*The Guardian*, 6 April 2011.) This article chronicles new improvements in BBC technical infrastructure, including the coverage and consistency of news feeds and new applications to delve into existing program data.

Top Ten Trends

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. To assure this perspective, each advisory board researches, identifies, and ranks key trends that are currently affecting the practice of teaching, learning, and creative inquiry in education, and uses these as a lens for its work in predicting the uptake of emerging technologies in whatever region and sector is their focus.

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 an impact they are likely to have on education in the next five years. The following trends have been identified as key drivers of technology adoptions in Brazilian primary and secondary education for the period of 2012 through 2017; the trends are listed here in the order they were ranked by the advisory board.

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

2) The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators. Schools must consider the unique value that each adds to a world in which information is everywhere. In such a world, sense-making and the ability to assess the credibility of information are paramount. Mentoring and preparing students for the world in which they will live is again at the forefront. Schools have always been seen as critical paths to educational credentialing, but challenges from competing sources are redefining what these paths can look like.

3) People expect to be able to work, learn, and study whenever and wherever they want. This trend is certainly true for most adults, and many well-paying jobs literally can be done from anywhere that has a mobile Internet connection. It is also true for many of today's school-age children, who live their lives in a state of constant connection to their peers, social groups, and family. The implications for formal learning are profound, as the flipped classroom uses the resources on the Internet to free up valuable teacher classroom time, and fundamentally changes the teacher-student relationship. When students know how to use their network connections for more than texting, learning becomes much more serendipitous, opening the door to "just-in-time" learning, and "discovered" learning.

4) Schools are increasingly exploring technologies that allow teachers and students to better collaborate. Social networks and cloud-based tools and applications are changing the ways teachers and students communicate with each other. Open resources such as wikis and Google Apps also enable the free exchange of ideas and prompt insightful discussions between teachers and students. The result is more opportunities for collaboration, and a change in the dynamic of the teacher-student relationship that promotes more of an equilibrium.

5) The growing availability of bandwidth will dramatically change user behaviors in teaching, learning and research over the next five years. The advent of cloud computing has alleviated the burden of storing software, email services, and other applications locally. Major resources are now accessible via web browser in just one click, no longer bogging down computer speed. Students and educators can now connect and collaborate with more ease, transfer files and information quicker, and store more new content.

6) The technologies we use are increasingly 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 even 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 used to a model of browser-based software that is device-independent. While some challenges still remain, specifically with notions of privacy and control, the promise of significant cost savings is an important driver in the search for solutions.

7) Humans have a need to share — often publicly. Initially identified by Gartner, this trend refers to the desire inherent in our character to share what we have learned with our peers. Sharing something new is an exciting event, and when placed online, each bit of information feeds the diverse tapestry of the Internet. The voices of individuals can be accessed on demand through the cloud. Gartner's 2012 Hype Cycle illustrates this trend and explores the technologies that enable it, including automatic content recognition, crowdsourcing, big data, social analytics, activity streams, cloud computing, audio mining/speech analytics, and text analytics.

8) 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 more advanced equipment in their personal lives than at school.

9) There is a new emphasis in the classroom on more challenge-based and active learning. Challenge-based learning and similar methods foster more active learning experiences, both inside and outside the classroom. As technologies such as tablets and smartphones now have proven applications in schools, educators are leveraging these tools, which students already use, to connect the curriculum with real life issues. The active learning approaches are decidedly more student-centered, allowing them to take control of how they engage with a subject and to brainstorm and implement solutions to pressing local and global problems. The hope is that if learners can connect course material with their own lives and their surrounding communities, then they will become more excited to learn and immerse themselves in the subject matter.

10) Computers as we know them are in the process of a massive reinvention. The computer is smaller, lighter, and better connected than ever before, without the need for wires or bulky peripherals. In many cases, smart phones and other mobile devices are sufficient for basic computing needs, and only specialized tasks require a keyboard, large monitor, and a mouse. Mobiles are connected to an ecosystem of applications supported by cloud computing technologies that can be downloaded and used instantly, for pennies. As the capabilities and interfaces of small computing devices improve, our ideas about when — or whether — a traditional computer is necessary are changing as well.

Top Ten Challenges

Along with the trends discussed in the preceding section, the advisory board noted a number of important challenges faced by Brazilian primary and secondary educators. Like the trends, the ten 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 Brazilian schools in the coming five years are listed here, in the order of importance assigned them by the advisory board.

1) Teacher training should be modified to adapt to new students and new technologies. Teacher education programs must reflect the needs of current day learners. These learners come to the school environment accustomed to a culture of interactivity with the world and ideas. Brazilian schools are not currently prepared for such students and are not adapting as fast as they could be. Pre-service teachers need to know how to adequately integrate technology with pedagogical intent and at a minimum understand how technologies commonly used outside schools can be applied in teaching and learning.

2) Using technology is not enough; it is also necessary to change educational and teaching methodologies. Now that Information can be accessed anytime and anywhere, the role of the teacher is changing. Teachers have the responsibility to guide students, to help them find needed resources on the Internet, to critically evaluate their choices, and to use technology to support their learning, much as they would a pencil. New mobile and network-friendly pedagogies are needed, and new ideas such as the Flipped Classroom must be more easily applied.

3) The educational curriculum needs reinvention. Much of the current curriculum available in Brazilian schools was developed for a pencil-and-paper driven, teacher-led learning environment. As students increasingly are able to access the Internet and other technologies outside of school, expectations are that access in school will be even more pervasive. Interdisciplinary activities and more active learning are increasingly seen as not only valuable approaches, but also for developing 21st Century competencies. The kinds of conversations between universities, schools, and stakeholders that would lead to a new national perspective on this point are not yet happening.

4) Learning that incorporates real life experiences is not occurring enough and is undervalued when it does take place. This challenge is an important one in primary and secondary schools, because it results in a lack of engagement in learning on the part of students who are seeking some connection between their own lives and their experience in school. Use of technology tools that are already familiar to students, project-based learning practices that incorporate real-life experiences, and mentoring from community members are a few practices that support increased engagement. Practices like these may help retain students in school and prepare them for further education, careers, and citizenship in a way that traditional practices are failing to do.

5) Brazil needs better infrastructure to make full use of the Internet. Lack of sufficient broadband in Brazil is a major hindrance to accessing resources, collaborating online, and many other activities common in other parts of the world, but less so in Brazil because they are broadband dependent. While many teachers and learners already own mobile devices, simple tasks such as browsing the Internet are not yet guarantees across the nation. This challenge has spurred government initiatives, such as Plano Nacional de Banda Larga, to expand broadband access, with the hope that once Internet access is more ubiquitous, schools will be more likely to make use of technologies commonly used for teaching and learning elsewhere.

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

7) Schools need to embrace the increased blending of formal and informal learning. Traditional lectures and subsequent testing are still dominant learning vehicles in Brazilian schools. In order for students to get a well-rounded education with real world experience, they must also engage in more informal in-class activities as well as learning to learn outside the classroom. Most schools are not encouraging students to do any of this, nor to experiment and take risks with their learning — but a new model, called the "flipped classroom," is opening the door to new approaches. The flipped classroom uses the abundance of videos on the Internet to allow students to learn new concepts and material outside of school, thus preserving class time for discussions, collaborations with classmates, problem solving, and experimentation.

8) The quality of public education needs to be improved. There are many barriers to the improvement of schools in Brazil generally, including inadequate (or inappropriate) use of available funding, the ever present need for more funding, deferred school upkeep, low salaries, and poor working conditions for teachers. The public education system needs better, more experienced management to address these challenges, as currently too many decisions are being made for political, rather than educational gain. Decision makers who know the benefits of collaboration and how technology might be applied to face the challenges schools face could make a real impact on overall school quality.

9) Many activities related to learning and education take place outside the walls of the classroom and thus are not part of traditional learning metrics. Students can take advantage of learning materials already present in many non-school situations, such as games, programs they may have on systems at home, or through their extensive — and constantly available — social networks. The experiences that happen in and around these venues are difficult to tie back to the classroom, as they tend to happen serendipitously and in response to an immediate need for knowledge, rather than being related to topics currently being studied in school.

10) Putting 21st century technology into 19th century schools is a major undertaking. The influence of the 19th century maintains a strong hold on the educational practices in all too many schools in Brazil today, from the outdated, industrial nature of existing school buildings to the old learning models and processes enshrined therein. Brazilian schools are clearly under pressure to change. Many see new technologies and new tools as the antidote to a system badly in need of updating. At the same time, the task is enormous, and the rural areas of the country are especially challenged, not just in terms of basic information-economy infrastructure, but also in terms of culture and expectations.

Methodology

The process used to research and create the *Technology Outlook for Brazilian Primary and Secondary Education 2012-2017: 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 for Brazilian Primary and Secondary Education 2012-2017* 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 advisory board. As a general strategy, Horizon Project advisory boards are intended to represent a wide range of backgrounds and interests, yet with each member bringing a particularly relevant expertise. To date, hundreds of internationally recognised 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 this edition was established, their work began with a systematic review of the literature — press clippings, reports, essays, and other materials — that all pertained in some way to emerging technology. Advisory board members were provided with an extensive set of background materials when the project began, and then asked to comment on them, to identify those that seem especially worthwhile, and add to the set. The group discussed existing applications of emerging technology and brainstormed new ones. A key criterion for the inclusion of a topic was its potential relevance to teaching and learning in Brazil. A carefully selected set of RSS feeds from dozens of relevant publications ensured that background resources stayed current as the project progressed, and were used to inform the thinking of the participants throughout the process.

Following the review of the literature, the advisory board engaged in the central focus of the research — the research questions that are at the core of the NMC Horizon Project. These questions were 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 Brazilian primary and secondary education 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 some Brazilian schools and learning programs are using today that arguably ALL institutions and programs should be using broadly to support or enhance teaching and learning?
    b. What technologies that have a solid user base in consumer, entertainment, or other industries should Brazilian schools and learning programs be actively looking for ways to apply?

   c. What are the key emerging technologies you see developing to the point that Brazilian schools and learning programs 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 Brazilian schools and learning programs approach their core missions of teaching, citizenship development, and service?
4. What do you see as the key challenges related to teaching and learning that Brazilian schools and learning programs will face during the next five years?

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

In the first step of this approach, the responses to the research questions were systematically ranked and placed into adoption horizons by each advisory board member using a multi-vote system that allowed members to weight their selections. Each member was 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 were compiled into a collective set of responses, and the ones around which there was the most agreement were 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 at brasil.wiki.nmc.org.

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