



Horizon Project

2014 NMC Technology Outlook

International Schools in Asia

A Horizon Project Regional Report



2014 NMC Technology Outlook for International Schools in Asia

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2014 NMC Technology Outlook for International Schools in Asia A Horizon Project Regional Report

is a collaboration between

The New Media Consortium, Concordia International School Shanghai, and
NIST International School

With the support of 21 Century Learning, Canadian International School of Hong Kong, Eduro Learning, Innovative Professional Development, Nanjing International School, Renaissance College Hong Kong, Singapore American School, United World College of South East Asia, and Yokohama International School

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A Horizon Project Regional Report

Executive Summary

The *2014 NMC Technology Outlook for International Schools in Asia: A Horizon Project Regional Report* reflects a collaborative research effort between the New Media Consortium (NMC), Concordia International School Shanghai, and NIST International School in Bangkok, Thailand to help inform international school leaders in Asia about significant developments in technologies supporting teaching, learning, and creative inquiry in primary and secondary education.

All of the research underpinning the report makes use of the NMC's Delphi-based process for bringing groups of experts to a consensus viewpoint, in this case around the impact of emerging technologies on teaching, learning, and creative inquiry in international schools in Asia (ISA) 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 12 years ago to systematically identify and describe emerging technologies likely to have a large impact on education around the globe.

The *2014 NMC Technology Outlook for International Schools in Asia* was produced to explore emerging technologies and forecast their potential impact expressly in a primary and secondary education context. In the effort that took place from May through July 2014, a carefully selected panel of experts was asked to consider hundreds of relevant articles, news, blog posts, research, and project examples as part of the preparation that ultimately pinpointed the most notable emerging technology topics, trends, and challenges for international schools in Asia over the next five years.

Known as the 2014 Horizon Project ISA Expert Panel, that group of thought leaders consists of distinguished individuals, all highly regarded in their fields. Collectively the panel represents a range of diverse perspectives across the education sector for international schools in Asia. The project has been conducted under an open data philosophy, and all the interim projects, secondary research, discussions, and ranking instrumentation can be viewed at isasia.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.

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

NMC Horizon Report 2014 K-12 Edition	2014 Technology Outlook for International Schools in Asia	NMC Horizon Report Europe 2014 Schools Edition
Time-to-Adoption Horizon: One Year or Less		
Bring Your Own Device Cloud Computing Mobile Apps Tablet Computing	Cloud Computing Games and Gamification Makerspaces Mobile Apps	Cloud Computing Flipped Classroom Mobile Apps Tablet Computing
Time-to-Adoption Horizon: Two to Three Years		
3D Printing Games and Gamification Learning Analytics Makerspaces	3D Printing Learning Analytics Massive Open Online Courses Personal Learning Environments	Games and Gamification Learning Analytics Massive Open Online Courses Mobile Learning
Time-to-Adoption Horizon: Four to Five Years		
Flexible Displays The Internet of Things Virtual and Remote Laboratories Wearable Technology	The Internet of Things Virtual and Remote Laboratories Virtual Reality Wearable Technology	Personal Learning Environments Virtual Assistants Virtual and Remote Laboratories Visual Data Analysis

The 12 “technologies to watch” presented in the body of this report reflect our experts’ opinions as to which of the nearly 60 technologies considered will be most important to international schools in Asia over the five years following the publication of the report. As Table 1 above illustrates, the

choices of our experts overlap in interesting ways with those who contributed to the *NMC Horizon Report > 2014 K-12 Edition*, which looked at technology uptake in primary and secondary education from a global perspective, and the soon to be published *NMC Horizon Report Europe > 2014 Schools Edition*, which provides perspective on the technologies, trends, and challenges impacting Europe.

All three of these projects' expert panels — a group of 153 acknowledged experts — agree that cloud computing and mobile apps will likely tip into mainstream use within the next year — a trend that spans education across much of the world. In many ways, international schools in Asia are leading this effort, using cloud-based services such as Google Apps and Skype while also establishing their own cloud networks to increase access to content from mobile devices.

Additionally, the three panels demonstrated consensus around learning analytics being two to three years away from widespread penetration. Many international schools in Asia are starting to use learning management systems and applications that have built-in analytics to track student learning progress and behavioural patterns, making it easier to identify where they need extra help and in what areas they are excelling. However, research for this report indicates that this technology is mostly in the pilot phase at individual schools and large-scale implementations are distant. Also noteworthy is the panels' shared vision that virtual and remote laboratories will be broadly adopted in schools in five or more years. The proliferation of cloud computing in Asia is making it easier for students to run experiments in online environments, and even access and direct real, high-calibre equipment located in labs across the world.

While there are several other overlaps between the panels, there are some differences between perceived time-to-adoption horizons. For example, the Horizon Project ISA Panel feels that makerspaces are in the near-term, while the global 2014 Horizon Project K-12 Panel believes that they are further out at two to three years. Although many international schools in Asia do not have designated makerspaces on their campuses yet, the continent as a whole is home to a burgeoning maker community along with organisations that are devoted to advancing this movement, including DigiBook MakerSpaces and XinCheJian in China and Under the Hood in the Singapore. Many international school models capture the spirit of this technology, which is the promotion of students as creators who learn by experimenting. The placement of 3D printing in the mid-term horizon for both the ISA and global panels solidifies this move towards active learning.

Games and gamification made the list of technologies for all three panels, though it is worth pointing out that the ISA panel perceives it as garnering widespread adoption several years sooner. Many international schools in Asia, including NIST International School in Thailand and Changchun American International School in China, have already embedded gameplay into school curriculum and have even taken it a step further by creating opportunities for students to design their own games, learning vital computer science skills along the way.

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

NMC Horizon Report 2014 K-12 Edition	2014 Technology Outlook for International Schools in Asia	NMC Horizon Report Europe 2014 Schools Edition
Rethinking the Roles of Educators	Digital Delivery is Increasingly the Norm	Rethinking the Roles of Educators
Integration of Hybrid Learning Designs	Shift from Students as Consumers to Students as Producers	Integration of Hybrid Learning Designs
Rethinking How Schools Work	Rethinking How Schools Work	Rise of Data-Driven Learning and Assessment

Both the ISA panel and European panel agree that massive open online courses (MOOCs) are gaining traction, but expect they will take two to three years to fully come to fruition. While hybrid models of learning, such as the flipped classroom, are proving successful in schools, entirely virtual institutions and courses are currently more prominent in tertiary education. However, the notion of free and open courses that can be accessed from anywhere is appealing to parents and students who wish to learn from schools based in their native countries.

There was one distinct choice that distinguished the viewpoints expressed by the 2014 Horizon Project ISA Expert Panel from their counterparts in other regions of the world; virtual reality was proposed and selected by the panel as a brand new topic for this report. Emerging virtual reality products, such as Oculus Rift, have compelling potential applications for teaching and learning, especially when integrated into games. Lifelike simulations could, for example, enable students to travel to ancient civilisations without ever leaving the classroom. While concrete examples of virtual reality are not yet well-documented for international schools in Asia, the panel believes the technology will be widespread there in five or more years.

The nuances of the technologies and their associated adoption horizons featured in this report are specific to international schools in Asia, even if there are commonalities with other reports. Likewise, the key trends (Table 2 and pages 17-18) and significant challenges (Table 3 and pages 19-20) selected by the 2014 ISA panel distinctly reflect the current drivers and obstacles facing international schools in Asia 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 organised by time-based categories described in the corresponding sections of this report.

According to the ISA panel, digital delivery is a growing trend in their schools. Today, it is highly uncommon for a school to not have an online presence. Social media use, along with open content, are proliferating across the Internet, making it easier for teachers and students to discover relevant and timely resources while sharing their own. This trend has also sparked new learning approaches, such as the flipped classroom, in which much of the lectures and curriculum are placed online for students to access from home so that class time can be devoted to more hands-on and immersive activities. Several international schools in Japan and India, among other countries, have adopted flipped models.

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

NMC Horizon Report 2014 K-12 Edition	2014 Technology Outlook for International Schools in Asia	NMC Horizon Report Europe 2014 Schools Edition
Integrating Personalised Learning	Balancing Our Connected and Unconnected Lives	Integrating ICT in Teacher Education
Safety of Student Data	Integrating Personalised Learning	Creating Authentic Learning Opportunities
Keeping Education Relevant	Keeping Education Relevant	Students as Co-Designers of Learning

Additionally, the shift from students as consumers to students as creators is changing the way assignments and curricula are designed. Rather than learners demonstrating their knowledge of a subject by taking tests and writing papers, they are increasingly being encouraged to create video reflections and bring their creative ideas to life by making new products. This trend is reflected in some of the technologies selected by the ISA panel, including makerspaces, games and gamification, and 3D printing. In fact, the panel also perceives that the culmination of these trends

is causing school leaders to rethink how institutions work, along with the physical spaces that comprise them and how the school day itself is structured to promote more critical thinking and creativity.

Horizon Project panels in general have agreed that trends like these are clear drivers of technology adoption; the ISA 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.

The panel agreed that instilling a school and work/life balance is imperative as technology rapidly evolves and becomes more accessible. Technology use is perceived by the panel as a means to advance innovative pedagogies across the continent, but there is a need for both teachers and students to understand how to maximise productivity online and with their various devices, while not relying on these tools too much.

The panel also believes that these technologies, when applied effectively, can be portals to personalised learning. A student's collection of mobile apps, for example, reflects their interests and learning preferences. Giving students more autonomy over how they learn and what tools they use is a growing trend at international schools in Asia as traditional, prescribed methods of learning are increasingly seen as out-dated and do not meet all students' needs. However, to meet this challenge head-on requires harmony between the policies that govern the schools and the forms of student assessment that are used to measure success and knowledge gained through a wide variety of learning pathways.

Keeping education relevant is perceived by the ISA panel as a wicked challenge — one that is hard to define, let alone solve. Informal learning venues such as the Khan Academy are calling into question the necessity of brick-and-mortar institutions as students can now seemingly learn new skills from anywhere. Determining effective ways to expose students to real world scenarios and showing them how the subject matter they are learning in school impacts them and the world around them may be key to mitigating this major issue.

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 international schools in Asia over the next year, two to three years, and four to five years. Each page opens with a carefully crafted definition of the highlighted technology, outlines its educational relevance, points to several real life examples of its current use, and ends with a short list of additional readings for those who wish to learn more. Following those discussions are sections that detail the expert panel's top ranked trends and challenges, and frame them into categories that illuminate why they are seen as highly influential factors in the adoption or proliferation 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, 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 international schools in Asia. 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 *2014 NMC Technology Outlook for International Schools in Asia* is presented.

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 specialised data centres and consume almost no local processing or storage resources. Cloud computing resources support collaboration, file storage, virtualisation, 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. Schools are deploying similar cloud-based strategies to boost collaboration, productivity, and mobility in teaching and learning. The Asia Cloud Computing Association has been very active in helping to stimulate the effective use of the cloud across the continent; their 2014 Cloud Readiness Index evaluated Asia-Pacific countries to determine where there were growth opportunities and found that Thailand and the Philippines are setting a precedent for high-quality cloud infrastructures and widespread use.

Relevance for Teaching, Learning, or Creative Inquiry

- At the school level, flexible options for computing, bandwidth, and storage offered by providers can be reconfigured on the fly, and in most cases are considerably cheaper than the capital and operational costs of dedicated on-campus equipment.
- At the user level, secure cloud resources are less expensive than licenced products, and they increase access to storage, tools, media, and educational materials for learners.
- Cloud-based services support collaborative learning competencies, encouraging students to work simultaneously on a document in the same room or across continents.

Cloud Computing in Practice

- The International School of Manila transitioned to a cloud-based system in which 3,000 students and teachers are using and storing their data in Google Apps: go.nmc.org/manila.
- The Malaysia Education Blueprint is implementing a large-scale cloud solution that delivers up-to-date content and courseware to over 10,000 schools: go.nmc.org/malmini.
- Students at Sunway International School in Malaysia are accessing education software applications via the school's cloud network, which accommodates more than 12,000 users: go.nmc.org/sunway.

For Further Reading

4 Advantages of Cloud-based Technologies in the Classroom

go.nmc.org/fourad

(Adam Fort, *EdTech Review*, 31 May 2014.) Among the numerous benefits of using cloud services for education is the ability to create remote classrooms, access web-based educational apps, and connect to educational materials via mobile devices.

Some Schools Flirt with Cloud-based Education

go.nmc.org/cloudss

(Tracey E. Schelmetic, *TMCnet*, 7 January 2013.) The education ministry in Japan announced a pilot project for a cloud-based learning system to serve public primary, middle, and high schools.

Touch-On-Cloud Innovates Learning for Indian Students

go.nmc.org/cloudin

(Srinivas Kulkarni, *ZDNet*, 25 June 2013.) An Indian start-up has developed a learning system that allows students to digitally annotate their instructor's content on a whiteboard, which can be saved and accessed via the cloud to be reviewed at home.

Time-to-Adoption: One Year or Less

Games and Gamification

The culture around digital games is growing to encompass a substantial proportion of the world's population, with the age of the average gamer increasing every year. The gaming industry is producing a steady stream of games that continue to expand in their nature and impact — they can be artistic, social, and collaborative, with many allowing massive numbers of people from all over the world to participate simultaneously. A 2013 study by the American Psychological Association highlights the cognitive, motivational, emotional, and social impact video games have on human behaviour; this significant body of research underlines the overwhelming potential of games to teach new forms of thought and behaviour. Studies like these are encouraging the uptake of games into the worlds of commerce, the military, and education, among others. Gamification — the integration of gaming elements, mechanics, and frameworks into non-game situations and scenarios for training and motivational purposes — has added another level of complexity to discussions surrounding the potential of games to transform teaching and learning. The gamification of learning environments is rapidly gaining support among educators who recognise that effectively designed games stimulate large gains in engagement, productivity, creativity, and authentic learning.

Relevance for Teaching, Learning, or Creative Inquiry

- Gamified learning environments help students keep track of new skills as they gain them and motivate learners to pursue the next level of mastery.
- Goal-oriented learning is often inherent in educational games, fostering opportunities for the development of essential social skills such as collaboration and teamwork.
- Simulations and role-playing games allow students to experience real world challenges with room to try new, creative solutions and to learn from failures.

Games and Gamification in Practice

- At Bangkok Patana School in Thailand, children learned to create digital games using Scratch, which they presented in an Academy Awards-style show: go.nmc.org/patina.
- Changchun American International School students use Minecraft to learn fundamentals of urban planning, including design, transport, and policy: go.nmc.org/chun.
- Through Gamingspace, students at NIST International School in Thailand play video games that build 21st century skills: go.nmc.org/gspace.

For Further Reading

Gaming: Leveling Up Global Competence

go.nmc.org/leveling

(Honor Moorman, *Asia Society*, accessed 20 August 2014.) This article delves into the potential that digital games and simulated environments have to engage players in global issues such as human rights and world peace.

Global Demand for Game-Based Learning, Simulations on the Rise

go.nmc.org/globalgb1

(Sean Cavanagh, *Education Week*, 4 September 2013.) An analysis by Ambient Insight predicts that revenues for game-based learning will grow to \$2.3 billion by 2017, with China, India, and Indonesia being among the largest markets.

Play/Game-based Learning

go.nmc.org/playgb1

(National Institute of Education Singapore, accessed 12 September 2014.) Research from Singapore's government taskforce on gameplay has shown that challenges to adoption can be addressed through improved teacher professional development.

Time-to-Adoption: One Year or Less

Makerspaces

The turn of the 21st century has signalled a shift in what types of skillsets have real, applicable value in a rapidly advancing world. In this landscape, creativity, design and engineering are making their way to the forefront of educational considerations as tools such as 3D printers, robotics, and 3D modelling web-based applications become accessible to more people. The question of how to renovate or repurpose classrooms to address the needs of the future is being answered through the concept of makerspaces, or workshops that offer tools and the learning experiences needed to help people carry out their ideas. Makerspaces are intended to appeal to people of all ages, and are founded on an openness to experiment, iterate, and create. The driving force behind makerspaces is rooted in the maker movement, a following comprised of artists, tech enthusiasts, engineers, builders, tinkerers, and anyone else who has a passion for making things. The formation of the movement stems from the success of the Maker Faire, a gathering that launched in 2006, and has since propagated itself into numerous community-driven events all over the world. In Asia, there are numerous organisations devoted to expanding access to maker and hackerspaces, especially for young students, including XinCheJian and Under the Hood.

Relevance for Teaching, Learning, or Creative Inquiry

- Pedagogies such as inquiry-based learning and design thinking, which require learners to think like engineers by encouraging planning, construction, and delivery, are carried out in makerspaces.
- Makerspaces are accessed outside of scheduled classes provide a place for school faculty and students to pursue making activities on their own or participate in extracurricular camps that promote design skills with a variety of tools.
- Makerspaces equipped with technologies and construction supplies are all-purpose workshops that represent the power of creation in both the virtual and physical world.

Makerspaces in Practice

- 30 DigiBook MakerSpaces are providing a place where students create and publish original multimedia content in public libraries across China: go.nmc.org/dibook.
- In their Primary Years Programme, Nanjing International School students learned to code so that their “beebots” could follow a specific race course: go.nmc.org/beebe.
- NIST International School's MATCHED Makerspace provides a safe place for experimentation and flattens the walls of the school so students can connect to the world around them: go.nmc.org/nist.

For Further Reading

3 Key Qualities for a School Makerspace

go.nmc.org/zine

(Parker Thomas, *Make Zine*, 11 August 2013.) The authors created professional development sessions on maker activities, along with a library of Google hangouts on introductory projects and other topics.

In China, Lessons of a 'Hackerspace'

go.nmc.org/inchi

(Emily Parker, *Wall Street Journal*, 4 October 2013.) To advance the maker movement across the country, the Chinese government is building 100 “innovation houses.”

Making a Makerspace in Singapore

go.nmc.org/makesing

(SL2, 9 September 2013.) Sustainable Living created a series of posts chronicling the creation of a makerspace in Singapore and some of the unique challenges that Asian makerspaces face.

Time-to-Adoption: One Year or Less

Mobile Apps

For several years now, a revolution has been taking place in software development that parallels similar shifts in the music, publishing, and retail industries. Mass market is giving way to niche market, and with it, the era of highly priced large suites of integrated software has shifted to a new view of what software should be. Mobile operating systems such as Android and iOS have redefined mobile computing, and in the past three to four years, the small, low-cost software extensions to these devices — apps — have become a hotbed of development. Simple but useful apps have found their way into almost every form of human endeavour, and a popular app can see millions of downloads in a very short time. eMarketer predicts that by 2018, most countries in Asia will reach 50% for smartphone penetration. This growing market for apps has spawned a flood of creativity that is instantly apparent in the extensive collections available in the app stores. Online app marketplaces provide an easy and highly efficient way to deliver software that reduces distribution and marketing costs significantly. Mobile apps continue to gain traction in education because they are particularly useful for learning as they enable people to learn and experience new concepts wherever they are, often across multiple devices. Language apps have been helpful for international schools in Asia, where students are learning to assimilate into new cultures.

Relevance for Teaching, Learning, or Creative Inquiry

- Advancements in mobile software offer sophisticated tools that crunch numbers, create 3D images, and record environmental observations, which makes conducting scientific experiments outside of the classroom easier for students.
- As one-to-one tablet and BYOD initiatives are piloted and implemented in more schools, administrators, teachers, and students are using productivity apps and Web 2.0 tools such as Evernote, Dropbox, and Google Drive to organise information and collaborate on projects.
- Mobile apps are replacing worksheets, as there are now apps that offer interactive exercises, games, and activities of every kind across disciplines, including the creative arts.

Mobile Apps in Practice

- Buku Sekolah Elektronik is a program that was launched by the Indonesian government to provide students access to free digital textbooks through mobile apps: go.nmc.org/mah.
- A GSMA-facilitated partnership between the Philippines' Department of Education and three telecommunications firms led to the creation of mobile apps that offer youth new ways to engage in English language education: go.nmc.org/fil.
- A Singaporean student created the free app Edusnap that allows students to submit pictures of their questions so that other students can provide answers: go.nmc.org/snap.

For Further Reading

Apps: Global and Mobile Learning

go.nmc.org/global

(Asia Society, accessed 20 August 2014.) Asia Society compiled a list of apps that help users learn various subjects while building global competence and perspective.

Japanese Educational App Developer Smart Education Raises \$5.4 Million

go.nmc.org/oya

(Junya Mori, *The Bridge*, 18 February 2014.) An app called Oyako de Smahon focuses on digital creation through picture-drawing. It is being adopted at 250 nurseries in Japan, in hopes that apps will become as commonplace in early education as books.

Time-to-Adoption: Two to Three Years

3D Printing

Known in industrial circles as rapid prototyping, 3D printing refers to technologies that construct physical objects from three-dimensional (3D) digital content such as 3D modelling software, computer-aided design (CAD) tools, computer-aided tomography (CAT), and X-ray crystallography. A 3D printer builds a tangible model or prototype from the electronic file, one layer at a time, through an extrusion-like process using plastics and other flexible materials, or an inkjet-like process to spray a bonding agent onto a very thin layer of fixable powder. The deposits created by the machine are applied very accurately to build an object from the bottom up, layer by layer, with resolutions that, even in the least expensive machines, are more than sufficient to express a large amount of detail. The process even accommodates moving parts within the object. Using different materials and bonding agents, colour can be applied, and parts can be rendered in plastic, resin, metal, tissue, and even food. This technology is commonly used in manufacturing to build prototypes of almost any object (scaled to fit the printer, of course) that can be conveyed in three dimensions. Many 3D printing providers have emerged in Asia in the last few years, including the opening of a Stratasys office in Singapore. Asia now leads the United States in 3D printing investments; China alone recently pledged \$245 million to develop 3D printing tools and expertise.

Relevance for Teaching, Learning, or Creative Inquiry

- 3D printing allows for authentic exploration of objects that may not be readily available to schools, including animal anatomies, ancient artifacts, and toxic materials.
- 3D printing shows promise as a rapid prototyping and production tool, providing students with the ability to touch, hold, and even take home a concrete model of their idea.
- The exploration of 3D printing, from design to production, as well as demonstrations and participatory access, opens up new possibilities for learning activities.

3D Printing in Practice

- The Destination Zero Carbon contest in Singapore rounded up 98 competing teams from schools in Asia to race cars produced using 3D printing technologies: go.nmc.org/zeroc.
- Students at the New Zealand International School in Indonesia are using 3D printers to learn processes of design and manufacturing: go.nmc.org/nzindo.
- The Taipei American School has two 3D Maker Bot printers that they are using in the Art + Innovation curriculum and robotics program: go.nmc.org/taipei.

For Further Reading

City X Project Establishes First Regional Partner in Singapore

go.nmc.org/cityx

(Terence Lee, *Tech in Asia*, 14 January 2014.) A 3D printing and design-thinking workshop for kids partnered with a Singaporean educational developmental organization, Clanworks, to integrate creative problem-solving into a story-based curriculum.

South Korea Unveils Plan to Pull Ahead in 3D Printing

go.nmc.org/kprint

(Hannah Rose Mendoza, *3DPrint*, 21 June 2014.) The South Korean government created the 3D Printing Industry Development Council to advance 3D printing across the country.

Taiwan Tech Minister Proposes to Increase Access to 3D Printing in High Schools

go.nmc.org/taiwan

(*TechNode*, 14 March 2014.) The writer discusses how the minister of science and technology in Taiwan aims to increase access to 3D printing for high school students.

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 analyse commercial activities, identify spending trends, and predict consumer behaviour. Education is embarking on a similar pursuit into data science with the aim of learner profiling, a process of gathering and analysing 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, personalised learning experiences.

Relevance for Teaching, Learning, or Creative Inquiry

- If used effectively, learning analytics helps surface early signals that indicate a student is struggling, allowing teachers and schools 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 enables teachers to more precisely identify students' learning needs and tailor instruction appropriately.

Learning Analytics in Practice

- Chungdahm Learning, an education company based in South Korea, has announced plans to partner with leading adaptive learning company Knewton to create digital lessons that continuously adjust to each student's needs: go.nmc.org/chungd.
- LACE is a collaboration of partners who seek to reduce risks and increase the benefits of learning analytics through unity of research, policy, and practice, while building communities of practice in the field: go.nmc.org/lace.
- The Pinyin Tutor has been used for the past several years at more than 30 institutions around the world to teach students to transcribe spoken Chinese phrases into Pinyin: go.nmc.org/stat.

For Further Reading

The Potential of Learning Analytics and Big Data

go.nmc.org/poten

(Patricia Charlton et al., *Ariadne Issue 7*, 19 July 2013.) The authors explore the potential, approaches, impacts, and needs for learning analytics in education and present some of the current tools and platforms being used.

The Role of Learning Analytics in Improving Teaching and Learning

go.nmc.org/roleof

(George Siemens, TLT Conference, 16 March 2013.) This keynote describes how the data gathered from learning software can be used to improve teaching and learning. He provides examples and case studies.

Teaching Remedial Grammar through Data-Driven Learning Using AntPConc

go.nmc.org/remed

(Kiyomi Chujo et al., *Taiwan International ESP Journal*, Vol. 5:2, 2013.) This report describes an English course designed to address grammar issues at remedial levels using a data-driven learning approach.

Time-to-Adoption: Two to Three Years

Massive Open Online Courses

When Stephen Downes and George Siemens coined the term in 2008, massive open online courses (MOOCs) were conceptualised as the next evolution of networked learning. The essence of the original MOOC concept was a web course that people could take from anywhere across the world, with potentially thousands of participants. The basis of this concept was an expansive and diverse set of content, contributed by a variety of experts, educators, and instructors in a specific field, and aggregated into a central repository, such as a web site. What made this content set especially unique was that it could be “remixed” — the materials were not necessarily designed to go together but became associated with each other through the MOOC. A key component of the original vision was that all course materials and the course itself were open source and free — with the door left open for a fee if a participant taking the course wanted university credit to be transcribed for the work. Since those early days, interest in MOOCs has evolved at an unprecedented pace, fuelled by the attention given in the popular press to high profile entrants like Coursera, Udacity, and edX. In these new examples, “open” does not necessarily refer to open content or even open access, but only equates to “no charge.” Through MOOCs, international students in Asia have more opportunities to connect with schools and content from their native countries. Ultimately, many challenges remain to be resolved in supporting learning at scale and being implemented effectively in primary and secondary education. The most compelling aspect of the proliferation of MOOCs is that it is helping frame important discussions about online learning that simply could not have taken place before the advent of actual experiments.

Relevance for Teaching, Learning, or Creative Inquiry

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

Massive Open Online Courses in Practice

- The creator of the Canvas LMS has released two Minecraft MOOCs to help teachers leverage the game in the classroom: go.nmc.org/moocmine.
- edX and GEMS Education have partnered to develop MOOCs exclusively for primary and secondary education, expecting their first release in late 2014: go.nmc.org/gemsex.
- A leadership forum convened Thai health professional educators to discuss innovations in education, including the use of MOOCs and iTunesU courses: go.nmc.org/thaimooc.

For Further Reading

MOOCs for Schools

go.nmc.org/moocschool

(Marc Boxser and Anant Agarwal, *Education Times*, 7 July 2014.) The United Nations estimates that 57 million children are not enrolled in any formal schooling, and MOOCs have the potential to help fill this education gap.

Opportunities and Challenges of MOOCs: Perspectives from Asia (PDF)

go.nmc.org/chenifla

(Joyce Chao-chen Chen, Proceedings from IFLA WLIC 2013, 31 May 2013.) This review of MOOCs in Asian countries includes a timeline of major developments for open learning and the opportunities it poses for cultivating literacy among rural populations.

Time-to-Adoption: Two to Three Years

Personal Learning Environments

Personal learning environments (PLEs) support self-directed and group-based learning, designed around each user's goals, with great capacity for flexibility and customisation. The term has been evolving for some time, but has crystallised 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 year, as smart phones, tablets, and apps have begun to emerge as a compelling alternative to browser-based PLEs and e-portfolios. Along with that, there has been a corresponding move away from centralised, server-based solutions to distributed and portable ones. Using a growing set of free and simple tools and applications, such as a collection of apps on a tablet, it is already quite easy to support one's ongoing social, professional, learning and other activities with a handy collection of resources and tools that are always present. 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 individualised by design, and thus different from person to person.

Relevance for Teaching, Learning, or Creative Inquiry

- Adaptive learning tools are increasingly seen as an important part of school-based PLEs. These tools are envisioned as providing students and educators with real-time information about how lessons are progressing, with adjustments made as needed.
- Inherently sensitive to learning needs, personal learning environments cater to individuals by providing different forms of materials, including text, audio, and video.
- Personalisation is seen as a key and necessary component of the next generation of schools and learning.

Personal Learning Environments in Practice

- At Yokohama International School students each have a personal blog which serves as an ongoing digital portfolio and space for reflection: go.nmc.org/yis.
- The INTUITEL system responds to each learner, monitors their progress and behaviour, combines these data with pedagogical and methodological knowledge, and then deduces optimal guidance and feedback: go.nmc.org/intu.
- weSPOT is a project that supports personal discovery learning so that students perform scientific inquiries and are supported by data analytics capabilities: go.nmc.org/wes.

For Further Reading

Adoption of a Personal Learning Environment and Network to Support Peer-Based Lifelong Learning (PDF)

go.nmc.org/plen

(Miriam L.N. Tsui et al., The Asian Conference on Society, Education and Technology, 2013.)

This paper describes a case study of how a group of students established and used a personal learning environment and network to facilitate learning in a Hong Kong university.

Mean What You Say: Defining and Integrating Personalised, Blended and Competency Education

go.nmc.org/mean

(iNACOL, October 2013.) The authors believe that a personalised learning model can be realised through competency-based blended learning.

TribaLearning Enters a Partnership with NUMU AL-ELMIA in Saudi Arabia

go.nmc.org/triba

(tribalearning.com, 25 June 2014.) TribaLearning announced a partnership with NUMU AL ELMIA in Saudi Arabia to distribute TribaLearning software to schools. Triba is a free, open system that lets students set goals, monitor their progress, and assess their learning.

Time-to-Adoption: Four to Five Years

The Internet of Things

The Internet of Things (IoT) is a network of connected objects that link the physical world with the world of information through the web. The advent of TCP/IP v6, launched in 2006, expanded the capabilities of the Internet, and enabled objects, sensors, and devices to be addressable and thus findable across the Internet. This augmented address space is particularly useful for tracking objects that monitor sensitive equipment or materials, point-of-sale purchases, passport tracking, inventory management, identification, and similar applications. Embedded chips, sensors, or tiny processors attached to an object enable helpful information about the object, such as cost, age, temperature, colour, pressure, or humidity to be transmitted over the Internet. This simple connection supports remote management, status monitoring, tracking, and alerts if the objects they are attached to are in danger of being damaged or spoiled. Many web tools allow objects to be annotated with descriptions, photographs, and connections to other objects, and other contextual information; the Internet of Things makes access to these data as easy as it is to use the web. To date, however, there are not many well-documented applications of IoT in international schools in Asia, though examples in tertiary education reflect the great potential for schools.

Relevance for Teaching, Learning, or Creative Inquiry

- Big data will have a significant impact on IoT in education, as information transmitted from students' mobile devices leads to improved understanding of learner behaviours.
- Integration of IoT raises concerns about privacy, resulting in research efforts to identify incentives that encourage schools, educators, students, and parents to share data openly.
- Networked sensors make it possible to study objects that cannot be reached or touched, such as living things like marine life and ancient artifacts.

The Internet of Things in Practice

- The DISTANCE project is working with schools to define how IoT enhances learning in science and other subjects, such as technology and geography: go.nmc.org/iotsch.
- Students at Sookmyung Women's University use their phones to enter secured buildings by waving them in front of sensors and to reserve their places with apps that detect NFC tags attached to seats in lecture halls and libraries: go.nmc.org/explores.
- Two Chinese e-commerce firms are launching cloud platforms to help manufacturers with services they may need to produce smart appliances: go.nmc.org/ecommm.

For Further Reading

5 Reasons the Maker Movement Will Drive The Internet of Things

go.nmc.org/reasons

(James Mack, *Kore Wireless*, 16 June 2014.) The maker movement has led more people taking on a DIY approach to creating and innovating, which are affecting both the consumer and business markets.

The Internet of Things Will Thrive by 2025

go.nmc.org/thrive

(Janna Anderson, Lee Rainie, Pew Research Internet Project, 14 May 2014.) The Pew Research Center Internet Project interviewed 1,867 experts and IoT stakeholders, and this report analyses their opinions about the likely expansion of the Internet of Things.

IoT Asia Panel on How to Define Success and Avoid Failure

go.nmc.org/iota

(*M2M Now Magazine*, 11 July 2014.) In this session from IoT Asia, an expert panel discusses what can be learned from Internet of Things failures to highlight security risks and understand how to achieve success.

Time-to-Adoption: Four to Five Years

Virtual and Remote Laboratories

Virtual and remote laboratories reflect a movement among education institutions to make the equipment and elements of a physical science laboratory more easily available to learners from any location, via the web. Virtual laboratories are web applications that emulate the operation of real laboratories and enable students to practice in a “safe” environment before using real, physical components. Students can typically access virtual labs 24/7, from wherever they are, and run the same experiments over and over again. Some emerging virtual lab platforms also incorporate reporting templates that populate with the results of the experiments so that students and teachers can easily review the outcomes. Remote laboratories, on the other hand, provide a virtual interface to a real, physical laboratory. Institutions that do not have access to high-calibre lab equipment 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 behaviour and allows them access to professional laboratory tools from anywhere, whenever they need. Additionally, remote labs alleviate some financial burden for schools 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 feel more comfortable making mistakes and run experiments in complete safety.
- Teachers play back videos of the experiments students have run online, pinpoint areas for improvement or further discussion, 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. In school settings, it solves a number of issues involved with having children around potentially dangerous materials and processes.

Virtual and Remote Laboratories in Practice

- The Go-Lab Portal offers students the opportunity to perform personalised scientific experiments with online labs: go.nmc.org/golab.
- Labster created a virtual lab where an interactive molecular 3D animation makes molecular processes visible that would otherwise be typically obscured behind the walls of physical machinery: go.nmc.org/labst.
- Virtual Labs is an initiative of the Ministry of Human Resource Development in India, offering a complete LMS to run any of their virtual and remote labs: go.nmc.org/vlabs.

For Further Reading

Bringing Remote Labs and Mobile Learning Together

go.nmc.org/bringing

(Dominik May et al., *IJIM*, May 2013.) This paper describes how remote laboratories for engineering are linked with mobile devices and e-portfolios to create a unique learning environment, which documents each learner's personal learning process.

zSpace STEM Lab Adds Real-Time Sharing, Physics Simulations, Virtual Circuitry Lab

go.nmc.org/zspace

(Leila Meyer, *THE Journal*, 2 July 2014.) zSpace unveiled new software applications for its zSpace STEM Lab, an interactive, virtual platform for primary and secondary students that combines a specialised 24-inch high definition display with built-in tracking sensors that enables students to conduct experiments.

Time-to-Adoption: Four to Five Years

Virtual Reality

Virtual reality (VR) refers to computer-generated environments that simulate the physical presence of people and/or objects and realistic sensory experiences. At a basic level, this technology takes the form of 3D images that users interact with and manipulate via mouse and keyboard. More sophisticated applications of virtual reality allow users to more authentically feel the objects in these displays through gesture-based and haptic devices, which provide tactile information through force feedback. While enabling people to explore new environments has compelling implications for learning, to date, virtual reality has been most prominently used for military training. Thanks to advances in graphics hardware, CAD software, and 3D displays, virtual reality is becoming more mainstream, especially in the realm of video games. Oculus VR, a company focused on designing virtual reality products, is developing the heavily-anticipated Oculus Rift, a head-mounted display for gameplay to make the game environments and actions more lifelike. As both games and natural user interfaces are finding applications in classrooms, the addition of virtual reality can potentially make learning simulations more authentic for students.

Relevance for Teaching, Learning, or Creative Inquiry

- Many virtual reality technologies are already affordable and readily available; students have the opportunity to construct their own VR content as they go, using mobile apps such as Cardboard.
- Through online platforms such as EON Reality, teachers create their own virtual environments by uploading videos and instructional materials and combining them with 3D content.
- Virtual reality constructs provide contextual, in situ learning experiences that foster exploration of real world data in virtual surroundings and simulations. For example, students can take field trips to ancient civilisations from their classrooms.

Virtual Reality in Practice

- A pilot program at Garner Bullis Elementary School is introducing learners to STEM disciplines via a 3D educational display that students interact with using a stylus and polarised glasses: go.nmc.org/eduplay.
- Students of the Entrepreneur School at Namseoul University in South Korea are learning interactive media, 3D technologies, and virtual reality solutions: go.nmc.org/vrkorea.
- A summer institute is teaching high school students computer programming as they design 3D worlds they can experience using 3D imaging goggles: go.nmc.org/wyhigh.

For Further Reading

This Virtual Reality Game About Cheating Dolphins in An Undersea Classroom Shows 'Real' Next-Gen Play

go.nmc.org/dolphins

(Ben Kuchera, *Polygon*, 10 January 2014.) Oculus Rift developed a new piece of hardware that incorporates an OLED screen intended to decrease motion blur as well as positional tracking. The new technology was demonstrated in Classroom Aquatic, a new game that immerses the user in a classroom environment.

Virtual Reality Has Huge Implications for Education, Oculus Rift Creator Says

go.nmc.org/vrrift

(Eddie Makuch, *Gamespot*, 8 January 2014.) The creator of Oculus Rift believes that virtual reality technology enriches learning by allowing students to experience places like Ancient Rome or Egypt, or conveying visual concepts such as all of the planets to scale.

Time-to-Adoption: Four to Five Years

Wearable Technology

Wearable technology refers to devices that are worn by users, taking the form of an accessory such as jewellery, sunglasses, a backpack, or even actual items of clothing such as shoes or a jacket. The benefit of wearable technology is that it conveniently integrates tools that track sleep, movement, location, social media, and even new classes of devices that are seamlessly integrated with a user's everyday life and movements. Google's "Project Glass" was one of the earliest examples, and enables a user to see information about their surroundings displayed in front of them. Smart watches have also become commonplace, allowing users to check emails and perform other productive tasks through a tiny interface. Additionally, a rapidly growing category of wearable technology takes advantage of the burgeoning interest in the "quantified self." The Jawbone UP and Fitbit bracelets are two examples that track how you eat, sleep, and move. Empowered by these insights, many individuals now rely on these technologies to improve their lifestyle and health. Today's wearables not only track where a person goes, what they do, and how much time they spend doing it, but now what their aspirations are and when those can be accomplished.

Relevance for Teaching, Learning, or Creative Inquiry

- The next wave of wearable technology, implantable devices, can be embedded under a person's skin to detect and even dispense treatment for health issues.
- Students already spend time in formal classroom settings gathering data about themselves or research topics. Quantified self-enabled wearables tap into this interest to make the data collection process much easier.
- Wearable devices such as the Memoto, a camera worn around the neck that captures an image every half minute, are enabling people to track their surroundings automatically — a particularly interesting dimension for student fieldwork.

Wearable Technology in Practice

- A middle school social studies teacher uses a Pebble Smart Watch to track individual students' progress using the messaging feature: go.nmc.org/pebteach.
- A school principal at McFarlane Park Elementary asked a year one student to wear a GoPro camera so that she could experience school through his eyes: go.nmc.org/goproday.
- Students at Concordia International School wear iPod touches in a belt strap during physical education, allowing them to count steps, film workouts, take photos, and update their blogs with quick reflections: go.nmc.org/conco.

For Further Reading

The Future of Education as Seen Through Google Glass

go.nmc.org/glassm

(Andrew Marcinek, *Edutopia*, 30 January 2014.) A teacher describes his first day wearing Google Glass at school and his students' reactions.

Imagining the Classroom of 2016, Empowered by Wearable Technology

go.nmc.org/empower

(Rick Delgado, *Emerging EdTech*, 20 April 2014.) A technologist envisions applications of wearable devices in learning environments, such as creating instructional videos.

Meet K-Glass: Korea's Answer to Google Glass

go.nmc.org/kglass

(Min-Jeong Lee, *Wall Street Journal*, 5 March 2014.) A team of Korean researchers developed a wearable smart device that recognises objects without barcodes or physical markers.

Key Trends Accelerating Technology Adoption

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 panel member researches, identifies, and ranks key trends that are currently affecting teaching, learning, and creative inquiry in international schools in Asia, and uses these as a lens for the panel's work in predicting the uptake of emerging technologies.

These nine trends, which the expert panel agreed are very likely to drive technology planning and decision-making over the next five years, are sorted into three time-related categories — fast-moving trends that will realise their impact in the next one to two years, and two categories of slower trends that will realise their impact within three to five (or more) years.

Fast Trends

Driving Ed Tech adoption in international schools in Asia over the next one to two years

Digital Delivery is Increasingly the Norm. Thanks to the growing availability of free content, 150 million new Internet users have emerged in Asia Pacific since October 2012, according to Singapore-based firm We Are Social. With the rise of free services including TED talks, Wikipedia, the Khan Academy, and many others, international schools in Asia continue to experience a paradigm shift in which online learning represents the intersection of formal and informal learning. The flipped classroom, for example, is gaining traction as a blended environment, in which students watch video lectures and collaborate on assignments from home so that class time is devoted to more hands-on and immersive learning. DY Patil International School in India has been successfully piloting this model.

Growing Ubiquity of Social Media. Social media is changing the way people interact, present ideas and information, and judge the quality of content and contributions. In 2013 alone, the total number of social media users across the top network in 24 Asia nations increased to 874 million — an 18% growth from 2012. Educators, students, and the general public routinely use social media to share news about scientific and other developments. The impact of these changes in scholarly communication and on the credibility of information remains to be seen, but it is clear that social media has found significant traction in almost every education sector.

Rethinking the Roles of Teachers. Teachers 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 teachers both inside and outside their schools; to routinely use digital strategies in their work with students; and to organise their own work and comply with administrative documentation and reporting requirements. The integration of technology into everyday life is causing many educational thought leaders to reimagine the way subjects and lessons are taught, with an emphasis on acting as guides and mentors to promote independent and active learning.

Mid-Range Trends

Driving Ed Tech adoption in international schools in Asia over the next three to five years

Increasing Use of Hybrid Learning Designs. Classroom-based learning increasingly includes online learning components, hybrid learning strategies, and an increased focus on collaboration within and outside the classroom. Schools that are making use of hybrid learning models are finding that using both the physical and the virtual learning environments to their highest potentials allows teachers to further personalise the learning experience, engage students in a broader variety of ways, and even extend the learning day. Hybrid models enable students to use the school day for group work and project-based activities, while using the

network to access readings, videos, and other learning materials on their own time, leveraging the best of both environments.

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

Shift from Students as Consumers to Students as Creators. A shift is taking place in the focus of pedagogical practice in international schools in Asia as students across a wide variety of disciplines are learning by making and creating rather than from the simple consumption of content. Creativity, as illustrated by the growth of user-generated videos and maker communities in the past couple years, is increasingly the means for hands-on learning.

Long-Range Trends

Driving Ed Tech adoption in international schools in Asia over the next five or more years

Massive Reinvention of the Personal Computer. The computer is smaller, lighter, and better connected than ever before, without the need for wires or bulky peripherals. In many cases, smartphones and other mobile devices are sufficient for basic computing needs, and only specialised tasks require a keyboard, large monitor, and a mouse. Mobiles are connected to an ecosystem of applications supported by cloud computing technologies that are 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.

Rethinking How Schools Work. There is a focused movement to reinvent the traditional classroom paradigm and rearrange the entire school experience. Century-old practices in which students learn subject by subject while uniformly facing the front of the classroom are perceived by many as an antiquated approach to teaching and learning. The multidisciplinary nature of project-based learning and other contemporary approaches has brought attention to innovative designs of the school atmosphere that link each class and subject matter to one another. As learning becomes more fluid and student-centred, some teachers and administrators believe that schedules should be more flexible to allow opportunities for authentic learning to take place and ample room for independent study.

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. As technologies such as tablets and smartphones are more readily accepted in schools, educators are leveraging these tools, which students already use, to connect the curriculum with real life applications. Active learning approaches such as problem- and challenge-based learning are decidedly more student-centred, allowing learners 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 connect the 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.

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 international schools in Asia that are impeding the uptake of emerging technologies. Because not all challenges are of the same scope, the discussions here are sorted into 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 categorised as complex to even define, and thus require additional data and insights before solutions will even be possible.

Solvable Challenges

Those which we both understand and know how to solve

Balancing Our Connected and Unconnected Lives. With the abundance of content, technologies, and overall participatory options, schools need to facilitate finding a balance between connected and unconnected life. With technology now at the centre of many daily activities, it is important that learners understand how to balance their connected life with other developmental needs. Schools should lead the way to 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.

Blending Formal and Informal Learning. Traditional approaches with roots in the 18th century and earlier are still very common in many schools, and often stifle learning as much as they foster it. As the Internet has brought the ability to learn something about almost anything to the palm of one's hand, there is an increasing interest in the kinds of self-directed, curiosity-based learning that has long been common in museums and science centres. These and other more serendipitous forms of learning fall under the banner of informal learning, and serve to enhance student engagement by encouraging them to follow their own learning pathways and interests. Many experts believe that blending formal and informal methods of teaching and learning create environments that foster experimentation, curiosity, and creativity.

Creating Authentic Learning Opportunities. Authentic learning, especially that which brings real life experiences into the classroom, is still all too uncommon in schools. Authentic learning is seen as an umbrella for several important pedagogical strategies with great potential to increase the engagement of students seeking connections between the world as they know it exists outside of school, and their experiences in school. Use of learning strategies that incorporate real life experiences, technology, and tools that are already familiar to students, and interactions from community members are examples of approaches that bring authentic learning into the classroom.

Difficult Challenges

Those we understand but for which solutions are elusive

Integrating Personalised Learning. Personalised learning includes a wide variety of approaches to support self-directed and group-based learning that are designed around each learner's goals. Solving this challenge means incorporating concepts such as personalised learning environments and networks, adaptive learning tools, and more into school activities. Using a growing set of free and simple resources, such as a collection of apps on a tablet, it is already quite easy to support one's ongoing social and professional learning and other activities with a collection of resources and tools that is always on hand.

Integrating Technology in Teacher Education. Teacher training still does not acknowledge the fact that digital media literacy continues its rise in importance as a key skill in every

discipline and profession. Despite the widespread agreement on the importance of digital competence, training in the supporting skills and techniques is rare in teacher education. As teachers begin to realise that they are limiting their students by not helping them to develop and use digital competence skills across the curriculum, the lack of formal training is being offset through professional development or informal learning. 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.

Keeping Student Data Safe. Safety of student data has long been a concern in primary and secondary education, which is evident through legislation that has been passed to safeguard students and their personal data, such as the Personal Data Protection Act in Asia. As schools embrace ubiquitous technology, and more learning takes place online, researchers are leveraging these digital learning environments to mine data, which can be used to decipher trends in student behaviour. International schools in Asia are adopting cloud computing to support adaptive learning, promote cost-savings, and encourage collaboration, but sometimes the safety of student data is threatened when third-party vendors provide low-cost software as a service in return for access to student data that they then profit from.

Wicked Challenges

Those that are complex to even define, much less address

Competition from New Models of Education. Across the board, institutions are looking for ways to provide a high quality of service and more learning opportunities. Massive open online courses are at the forefront of these discussions, enabling students to supplement and even replace their education and experiences at brick-and-mortar schools with increasingly rich, and often free, online offerings. This challenge impacts international schools in Asia uniquely because parents are increasingly able to enrol their children in virtual programs in their native countries rather than in the international schools established for them. At the same time, international school models often differ from other schools across the countries they reside in, offering more innovative and flexible learning approaches. However, some countries, such as China, do not permit nationals to attend international schools, creating a disparity between local and international school education that must be confronted.

Keeping Formal Education Relevant. Many pundits worry that if education does not adapt to the times, other models of learning will take its place. School stakeholders must address the question of what school can provide that other approaches cannot, and rethink the value of education from a student's perspective. International schools in Asia are uniquely poised to confront this challenge. With a wide variety of programs that venture outside of the traditional curriculum, the skills students need for their future are integrated. Students at International School Manila, for example, have the opportunity to frequently participate in service-oriented activities. Additionally, students in international schools usually only have the school as their hub and so values and attitudes that will help them are effectively taught. As a result, international schools have a high rate of success in college acceptance and employment.

Scaling Teaching Innovations. Schools are not adept at moving teaching innovations into mainstream practice. Innovation springs from the freedom to connect ideas in new ways. Schools generally allow students to connect ideas only in prescribed ways — sometimes these lead to new insights, but more likely they lead to rote learning. Current organisational promotion structures rarely reward innovation and improvements in teaching and learning. A pervasive aversion to change limits the diffusion of new ideas, and too often discourages experimentation.

Methodology

The process used to research and create the *2014 NMC Technology Outlook for International Schools in Asia: A Horizon Project Regional Report* 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 an internationally renowned panel of experts 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 *2014 NMC Technology Outlook for International Schools in Asia* can be found at isasia.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 recognised practitioners and thought leaders have participated in the NMC Horizon Project Expert Panel; in any given year, a third of the experts 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 key technologies will be most important to international schools in Asia 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 international schools in Asia and programmes are using today that arguably ALL institutions and programmes should be using broadly to support or enhance teaching, learning, or creative inquiry?*
 - b. *What technologies that have a solid user base in consumer, entertainment, or other industries should international schools in Asia and programmes be actively looking for ways to apply?*

- c. *What are the key emerging technologies you see developing to the point that international schools in Asia and programmes 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 international schools in Asia and programmes approach our core missions of teaching, learning, and creative inquiry?*
4. *What do you see as the key challenges related to teaching, learning, and creative inquiry that international schools in Asia and programmes will face during the next five years?*

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 or trend would enter mainstream adoption — 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.) They also rank the degree and scope of each challenge as solvable, difficult, or wicked. These rankings are compiled into a collective set of responses, and inevitably, the ones around which there is the most agreement are quickly apparent.

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



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