Standards for technology-enabled learning

ITU-T Technology Watch Report
September 2012

Education is a pre-requisite to using information and communication technologies (ICTs) but these same technologies can be a tool to facilitate learning processes and education reaching beyond classrooms as we know them. This report surveys technology-enabled learning and emerging technologies, which, if applied in an educational context, can contribute to more efficient and more affordable education and training for all. For a number of years now, standardization bodies have been defining standards and guidelines for ICT-enhanced distance learning scenarios, and their output is taken up in this report with a view to exploring and identifying new applications and directions of this work.

The rapid evolution of the telecommunication/information and communication technology (ICT) environment requires related technology foresight and immediate action in order to propose ITU-T standardization activities as early as possible.

ITU-T Technology Watch surveys the ICT landscape to capture new topics for standardization activities. Technology Watch Reports assess new technologies with regard to existing standards inside and outside ITU-T and their likely impact on future standardization.

Acknowledgements

This report was written by Martin Adolph of the ITU Telecommunication Standardization Bureau. Please send your feedback and comments to tsbtechwatch@itu.int.

The opinions expressed in this report are those of the author and do not necessarily reflect the views of the International Telecommunication Union or its membership.

This report, along with other Technology Watch Reports can be found at http://itu.int/techwatch.

Cover picture by VLADGRIN, Shutterstock.

Technology Watch is managed by the Policy & Technology Watch Division, ITU Telecommunication Standardization Bureau.

Call for proposals

Experts from industry, research and academia are invited to submit topic proposals and abstracts for future reports in the Technology Watch series. Please contact us at tsbtechwatch@itu.int for details and guidelines.

Table of contents

Page

1. Introduction: Technologies improving educational access, equity and quality around the world

Education is a fundamental human right to which everyone is entitled.[1] Critical to our development as individuals and societies, education helps pave the way to a successful and productive future. Universal primary education is one of the eight millennium development goals which some 20 organizations including the International Telecommunication Union (ITU) have agreed to achieve by the year 2015 *("Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling")*.

Why? Because education enhances lives, ends generational cycles of poverty and disease, and provides a foundation for sustainable development. Indeed it has been argued, with much supporting evidence, that education is in itself a key to accomplishing other millennium development goals.

Education and learning go far beyond the confines of formal curricula, academic calendars and institutions such as schools and universities. In a learning society and in so-called "knowledge economies", memorization of facts and procedures is not enough for success.[2] Today's society relies on initial (early) education laying the foundation for informal and individual lifelong learning. Educated workers need a conceptual understanding of complex contexts, and the ability to work with them creatively to generate new ideas, new theories, new products, and new knowledge.

Moreover, social changes – such as growth in population numbers, diversity and mobility – are exerting growing pressure on traditional education systems and exposing the pressing need for innovation and reform in the education arena.

"The current education systems are facing unprecedented challenges. Traditional education systems alone, despite the essential role they have played, and will continue to play, in learning, are simply not capable of serving the world's growing and changing needs." John Chambers, Chairman & CEO, Cisco Systems.[3]

Tech-enabled reform:

Around the world and at all educational stages, ICT is a recognized means of satisfying the ever-growing thirst for knowledge and lifelong learning. The World Summit on the Information Society (WSIS), a series of UN-backed conferences held in 2003 and 2005, identified e-learning as a priority application, which, together with other applications and WSIS "Action Lines", facilitates achieving the millennium development goals. Delegates continue to meet regularly to assess country's progress regarding the WSIS "Action Lines".

Digital literacy (e-skills) has transcended barriers of age, class and income. ICTs are today close to ubiquitous and in many regions outnumber teachers and schools.

In some countries, ICT has been instrumental in providing a better life to underserved populations and in promoting individual socio-economic empowerment. In India, for example, the government plans not only to connect all the country's higher institutions of education and research (top universities, research centers, etc.), but also to provide broadband connectivity all the way down to *gram panchayat* (village council) level – aiming to connect the highest possible proportion of the world's largest democracy.[4]

---

[1] The Universal Declaration of Human Rights, Article 26, http://www.un.org/en/documents/udhr/

[2] OECD: *21st Century Learning: Research, Innovation and Policy.* 2008, http://www.oecd.org/dataoecd/39/8/40554299.pdf

[3] Cisco: *The Learning Society.* White paper, 2010, http://cisco.com/web/about/citizenship/socio-economic/docs/LearningSociety_WhitePaper.pdf

[4] Mint: *Govt to spend Rs1 trillion to democratize information.* 19 January 2012, http://livemint.com/2012/01/19235951/Govt-to-spend-Rs1-trillion-to.html

The benefits of coupling ICT and education are hardly news. In the 1930s for example, the Jim Hardy Organization produced a training film for General Motors illustrating the principles and development of the differential gear[5], and since 1951, the School of the Air has delivered lessons by radio to students in the remote outback of Australia.[6] In addition to its appearance as a tool to support traditional subjects (such as the differential gear) and as medium of knowledge exchange or providing access to learning resources (lessons via radio), ICT can itself form an educational subject (e.g., computer literacy, computer science) and of course also provides administrative tools supporting education (e.g., course management).

Film and video continue to play a leading role as support for learning and teaching, but it is clear that social change, globalization and recent advances in technology have significantly disrupted the education sector.

The following report highlights some of today's examples of ICT in education, focusing on ICT as a medium of knowledge exchange, as support to traditional subjects and as an administrative tool to support education. Readers will learn that the borders between these categories can be blurry and often overlap.

Finally, the report reviews technical standards and standardization activities supporting ICT in education in view of their applicability in tech-rich learning.

Some technologies have appeared on the screens or in the classrooms of educators only to disappear shortly thereafter. Recognizing the dynamic nature of the innovative ICT-in-education field, this report does not attempt to provide a comprehensive selection of emerging technologies or strategies, and readers are invited to search the Web for repositories of educational technologies at their discretion.[7]

The structure of the report is as follows:

Section 2 explores the use of ICT in education and learning by describing trends in purpose-built learning devices and all-purpose ICT devices used for learning.

Section 3 looks at different strategies to distribute educational resources.

Section 4 discusses tools that facilitate the learning process and interaction in and outside the classroom.

Section 5 reviews specific standardization activities catering to the needs of learners and the education sector, and

section 6 draws a number of conclusions.

Readers should note, and bear in mind throughout this report, that the use of ICT alone does not automatically imply a positive learning impact. Factors to be considered are the ways and circumstances in which ICT is used, the audience, etc. *"Asking for incontrovertible evidence of the benefits of ICT in a learning society may be no more sensible than to ask for the evidence about the value of books before buying any for schools."*[8]

[5] YouTube: *How Differential Gear works.* Uploaded by ConceptVBS, http://youtu.be/K4JhruinbWc

[6] Powerhouse Museum: *School of the Air.* http://powerhousemuseum.com/australia_innovates/?behaviour=view_article&Section_id=1010&article_id=10019

[7] See, for instance, infoDev: *Quick Guide to Low-Cost ICT Devices for Educational Systems in the Developing World.* Updated version, July 2010, http://infodev.org/devices-list-update

[8] OECD: *21st Century Learning: Research, Innovation and Policy.* 2008, http://www.oecd.org/dataoecd/39/8/40554299.pdf

2. Tech-rich learning: mobiles, tablets, laptops & Co.

In this section we describe educational ICT devices. The lines are blurring between categories of device, and definitions vary on what makes a device suitable in an educational context. Aforementioned radios and DVD players can be attributed an educational value, as can MP3 players, purpose-built educational devices, digital cameras, or video-gaming equipment.

Device Donations

Many people have benefitted from some form of computer-assisted learning in the computer lab of their school, university or workplace. In an attempt to spread the positive results gained in established knowledge societies, much equipment has been sold or donated to regions lacking access to ICTs. However, such donations often occur when ICTs cease to fulfill the growing requirements of their original users, and without considering the most basic yet very pertinent logistical questions regarding set-up, maintenance, local content and requirements. Sustainability, in both economic (e.g., cost of connectivity) and environmental (e.g., disposal of equipment and e-waste) terms must be addressed before shipping, and past mistakes teach us that to achieve their desired outcome, ICT donations must occur in parallel with ICT capacity building in recipient countries.

Any text on ICT in education warrants a sentence on the One Laptop per Child (OLPC) project. Nearly three million low-cost and low-power laptops have been distributed globally – to empower children through education. Hardware, software and content have been designed to facilitate collaborative, joyful, and self-empowered learning.[9]

Mobiles and Tablets

With some six billion subscriptions[10], mobile phones reach communities where educational opportunities are scarce. Countries that have traditionally been among the recipients of computer donations are among those with a high growth in mobile subscriptions.

Multi-faceted handsets are the Swiss army knives of the 21st century and are recognized tools in trade and banking, healthcare, farming and education. Today, SIM cards can be found in:

- Basic phones: Basic handsets that can make and receive voice calls, send and receive text messages and make use of Unstructured Supplementary Service Data (USSD) services.
- Feature phones: These handsets offer additional functionality and often include camera and additional storage space. They are often capable of accessing the Internet but generally have a standard numeric keypad.
- Smartphones: These handsets have advanced capabilities and allow users to add applications to their phones. They usually have a QWERTY keypad or onscreen virtual keyboard and include 3G and WiFi capabilities.
- Tablets: A tablet is a mobile computer, larger than a smartphone, integrated into a flat touch screen.

M-learning (mobile learning) overcomes the capacity limitations of fixed learning locations. Accessible from virtually anywhere, m-learning can include collaborative features for feedback and tips, as well as rich and entertaining content. Drawbacks of the mobile phone as learning platform can be seen in the small screen size, limited battery life[11], and the lack of interoperability in mobile operating systems, runtimes and formats.

[9] OLPC, http://one.laptop.org/about/mission

[10] ITU Information and Communication Technology (ICT) Statistics, http://itu.int/ITU-D/ict/

[11] ITU: *Batteries for portable ICT devices.* ITU-T TechWatch Alert, February 2010, http://itu.int/oth/T230100000E/

Tablets and digital textbooks (e-readers) are addressing the screen size challenge. Products in all price ranges are put on the market (see Box 1).

Box 1: Aakash

Image: Ubislate 7, initial version of the Aakash tablet

Part of a government funded program aimed at connecting as many as 35,000 colleges and 604 universities all over India, the initial version of the Aakash tablet was launched in 2011.[12] Originally dubbed the "$35 tablet", the current retail price is INR 2,999 or $54.[13] An overwhelming demand exists for these devices and potential customers typically remain on a waiting list for up to two months before being able to call Aakash or its successor their own. The tablet is shipped with the Linux-based mobile operating system, Android, which has in a short space of time achieved dominance in the mobile platform market. This is an important factor for attracting developers writing applications extending the functionality of devices (apps[14]). A particular app genre gives the tablet the ability to display and manage digital textbooks.

Considering today's state of technology, some experts suggest that ICTs present teaching tools far superior to those of heavy, static, paper-based textbooks. Today's textbooks should be portable, searchable and easy to update, giving students immediate feedback and demonstrating an ability to effortlessly load, close and manipulate diagrams and video content on a touchscreen.[15] In principle, any device with the capability to display text on a screen may act as an e-book reader. Some vendors, however, provide dedicated e-readers

[12] Business Standard: *Aakash 2 specifications by June-end: Sibal.* 3 June 2012, http://business-standard.com/india/news/aakash-2-specifications-by-june-end-sibal/166614/on

[13] Aakash Tablet, http://aakashtablet.com/

[14] ITU: *Mobile Applications.* ITU-T TechWatch Alert, July 2009, http://itu.int/oth/T230100000C/

[15] The Wall Street Journal: *Apple Jumps Into Textbooks.* 20 January 2012, http://online.wsj.com/article/SB10001424052970204555904577169523446883172.html

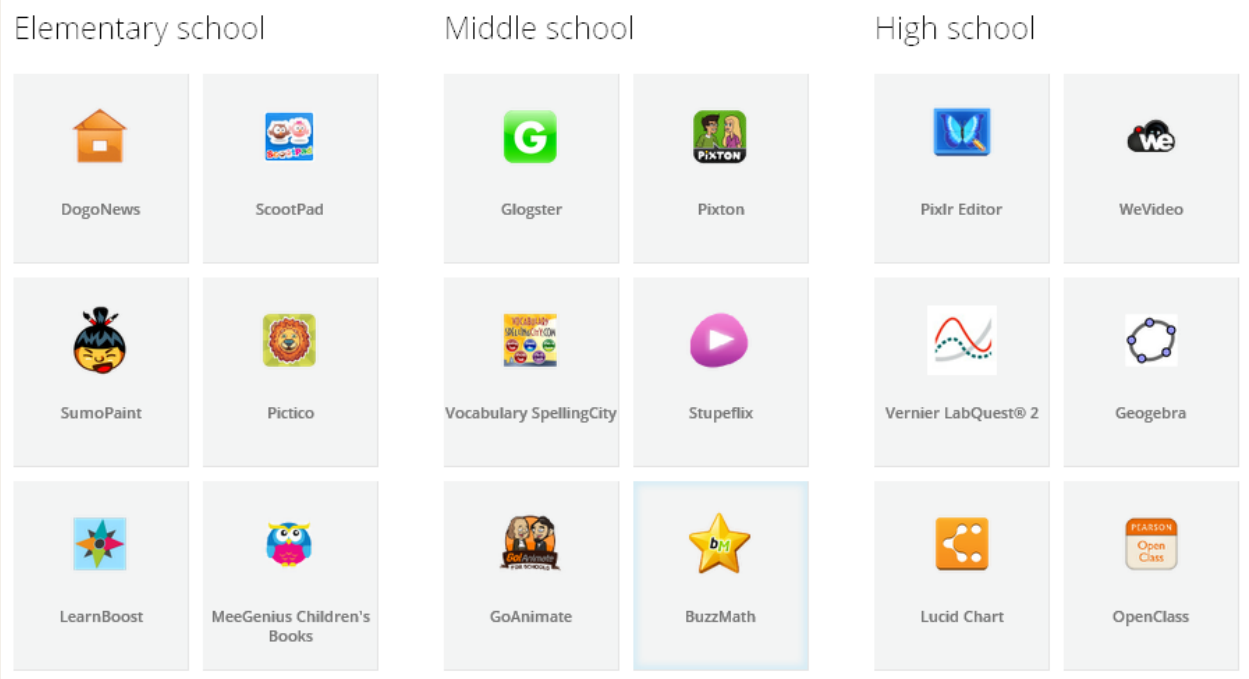
that focus on portability, readability and battery life to address the particular requirements of the application.

The Shift towards All-purpose ICTs

Programmers are populating app stores with a wide range of educational software addressing different needs and stages of learning. This recent shift to the availability of educational apps on smartphones, tablets and other all-purpose ICT gadgets poses serious competition to purpose-built educational devices.

The trend of moving away from developing specialized educational devices towards developing educational apps running on existing all-purpose devices is contributing to the increasing scalability and sustainability of ICT in education initiatives. New sets of apps can be installed, e.g., as learners graduate from elementary to middle to high school (see Figure 1), or to call on specific interests, strengths or weaknesses.

Figure 1: Application packs for elementary, middle and high school grades



Source: Google, http://www.google.com/intl/en/chrome/education/devices/gettingstarted.html

The shift towards offering educational services over all-purpose ICT devices has significant implications for standardization activities; in that many topics relevant to ICT in education need not be education-specific. Such topics include:

- Communication interfaces (3G, WiFi, Bluetooth, NFC (near-field communication)),
- Multimedia specifications (audio, image, video encoding),
- Accessibility and usability guidelines,
- Mobile operating systems (and the associated debate on native vs. Web applications).

ITU-UNESCO Broadband Commission for Digital Development

The UN Educational, Scientific and Cultural Organization (UNESCO) aims to attain quality *education for all* and promote *lifelong learning*.[16] UNESCO acknowledges that ICT can contribute to universal access to education, equity in education, the delivery of high-quality learning and teaching, teachers' professional development, and more efficient education management, governance and administration. In a series of working papers, UNESCO has highlighted the use of mobile technologies to support learners and teachers, concurrently examining the associated policy implications.[17]

These were taken up on the occasion of the 2012 World Summit of the Information Society (WSIS) Forum, where ITU and UNESCO held a session exploring the challenges and opportunities of mobile learning in supporting and promoting informal as well as formal methods of learning.[18]

Exploring and promoting the role of broadband in achieving *Education for All* is the objective of one dedicated Working Group within the Broadband Commission for Digital Development.[19] A joint ITU-UNESCO initiative, the Commission was launched in May 2010 and represents a community comprised of industry-leading CEOs, senior policy-makers and government representatives, international agencies, academic and research institutions, and a host of other organizations concerned with broadband-powered socio-economic development.

[16] UNESCO, the United Nations Educational, Scientific and Cultural Organization, http://www.unesco.org/new/en/unesco/themes/icts/

[17] UNESCO: *Working Paper Series on Mobile Learning.* http://unesco.org/new/en/unesco/themes/icts/m4ed/mobile-learning-resources/unescomobilelearningseries/

[18] ITU Academy: *ITU and UNESCO Present Joint Session on M-Learning at the WSIS Forum 2012.* 16 May 2012, http://academy.itu.int/news/item/946/

[19] Broadband Commission, Working Group on Education, http://www.broadbandcommission.org/work/working-groups/education.aspx

3. Free learning for all?

ICT devices are just one element of ICT in education, and it is equally important to discuss and develop the appropriate educational content, management tools and strategies of successfully implementing ICT in education.

Worldwide, there are many public, private, non-profit and for-profit institutions offering distance education. Courses range from the most basic instruction through to the most demanding postgraduate degrees and doctoral programs. A wide variety of methods are used for distance learning including written and audio materials, software and television programmes on DVD – with Internet-based content distribution and learning on the rise. Some establishments focus solely on distance education and thereby bring tuition to students otherwise unable to benefit from university education for economic, geographical, health-related, or other reasons.

Open Educational Resources (OER)

Learning resources, of key value to academic institutions, have for a long time been accessible only to enrolled students. However, times are changing, and a growing number of organizations, universities and individuals have come to realize that access to digital learning resources should no longer be limited to a privileged few. A growing number of syllabi and curricula are published and made accessible over the Internet as open educational resources (OER).[20]

"OER are teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use or re-purposing by others. Open educational resources include full courses, course materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge."[21]

Material published as OER is not equivalent to a university degree but can certainly form part of an academic degree based on distance learning, or can be recognized as credits to supplement formal university qualifications. Often associated with the OER movement is MIT OpenCourseWare (OCW), a distribution infrastructure for more than 2,100 undergraduate and graduate-level courses of the Massachusetts Institute of Technology.[22] The most visited courses include *"Introduction to Computer Science and Programming," "Classical Mechanics"* and *"Linear Algebra."* Many OCW course materials are also translated into Spanish, Portuguese, Simplified Chinese, Traditional Chinese, Thai, Persian and Turkish. According to MIT, its lectures are accessed about a million times per month, translated roughly 500,000 times by learners around the globe (see Figure 2).[23]

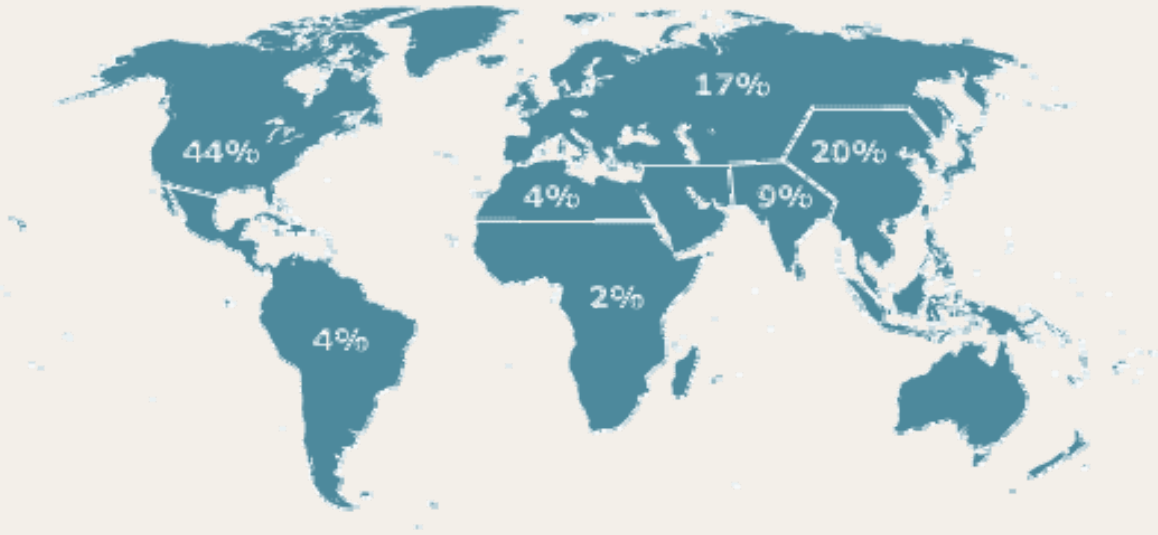
[20] OECD: *Giving Knowledge for Free - The Emergence of Open Educational Resources.* 22 May 2007, http://www.oecd-ilibrary.org/education/giving-knowledge-for-free_9789264032125-en

[21] The William and Flora Hewlett Foundation: *A Review of the Open Educational Resources (OER) Movement: Achievements, Challenges, and New Opportunities.* February 2007, http://hewlett.org/uploads/files/Hewlett_OER_report.pdf

[22] MIT OpenCourseWare, http://ocw.mit.edu/

[23] MIT OpenCourseWare, http://ocw.mit.edu/about/site-statistics/

Figure 2: Distribution of OpenCourseWare users worldwide



Source: MIT, http://ocw.mit.edu/about/site-statistics/

Harvard University *"opened its classroom to the world"* and invited the philosophy-savvy Web audience to find answers to enduring questions such as *"What's the right thing to do?"*[24] Lectures and lecturer, Michael J. Sandel, became popular in China and Japan where universities now offer philosophy classes following a similar style.[25]

Recently, Harvard and MIT together launched the edX joint initiative to offer online learning to more learners around the world and to anyone with an Internet connection.[26] More than just a repository of educational resources, such as OCW, courses available on edX will be taught using an interactive open-source online learning platform. Online learners who demonstrate mastery of subjects can earn a certificate of completion. However, to be awarded a prestigious Harvard or MIT degree, one must still enroll in an on-campus course.

Related platforms and services include Academic Earth (videos and lectures from some 30 universities)[27], Connexions (an OER repository of some 17,000 learning materials accessed by two million people per month)[28], Coursera (video lectures and assignments)[29], OpenStax College (peer-reviewed digital textbooks)[30], Udacity (video lectures in conjunction with integrated quizzes and follow-up homework)[31] and 2tor[32], a company aiding universities in efforts to offer degrees online.

[24] Harvard University's Justice, http://justiceharvard.org/

[25] The New York Times: *Justice Goes Global.* 14 June 2011, http://nytimes.com/2011/06/15/opinion/15friedman.htm

[26] edX, http://edxonline.org/

[27] Academic Earth, http://academicearth.org/

[28] Connexions, http://cnx.org/

[29] Coursera, https://www.coursera.org/

[30] OpenStax College, http://openstaxcollege.org/

[31] Udacity, http://udacity.com/

[32] 2tor, http://2tor.com/ and http://www.forbes.com/sites/ilyapozin/2012/05/09/10-startups-changing-the-world-and-what-we-can-learn-from-them/

Educational Video: YouTube & TED Talks

The biggest platform for educational content may well be the video-sharing site, YouTube.

Global video-coding standards such as Recommendation ITU-T H.264 facilitate the creation, compression and distribution of multimedia content, independent of device (e.g., smartphone, tablet, PC, DVD, digital TV), operating system and distribution platform.[33] The development of a new standard as well as extensions to ITU-T H.264 is underway, and these recommendations will support 3D capability at an even more efficient compression rate. All of this raises anticipation for innovative implementation of video standards in many applications, including teaching and learning.

A well-known example for educational video, Khan Academy, is described in Box 2.

TED, famous for its videos of inspirational 18-minute talks on a diverse range of topics and *ideas worth spreading* can be considered an educational resource in itself. In addition, the curators have launched a platform for educational video clips, enriched with quizzes and further food for thought.[34]

iTunes

Apple is also playing in the upper league of educational content. An education-focused category of the digital media store, iTunes, lists some 500,000 free audio lectures, videos and books suitable for learners of all ages. With the help of an authoring tool, educators are invited to convert their own content into modules accessible to the company's mobile devices.

Video Games

Educational games are another genre of learning resource, and a previous Technology Watch report on video games and gaming described the notion of "gamification" and video games' role as a powerful tool in developing problem-solving skills.[35] A recent MIT study notes that, *"game players regularly exhibit persistence, risk-taking, attention to detail and problem solving skills, all behaviors that ideally would be regularly demonstrated in school. […] game environments enable players to construct understanding actively, and at individual paces, and […] well-designed games enable players to advance on different paths at different rates in response to each player's interests and abilities, while also fostering collaboration and just-in-time learning."*[36]

"Who is an educator?"

This brings us to the question, *"Who is an educator?"*

As proven by Khan, anyone with an Internet connection can create and publish educational content. Web 2.0 features like 'rating', 'commenting' and 'sharing' help to promote the best user-generated content. Following the motto attributed to Albert Einstein, *"Teaching should be such that what is offered is perceived as a valuable gift and not as a hard duty,"* educators and learners alike populate thematic peer-to-peer (P2P) learning websites. For instance, Codecademy is a quickly growing P2P academy for programming languages.[37]

---

[33] ITU: *Recommendation ITU-T H.264*. Edition 7, January 2012, http://itu.int/ITU-T/H.264

[34] TED-Ed, http://ed.ted.com/

[35] ITU: *Trends in Video Games and Gaming.* ITU-T Technology Watch Report, September 2011, http://itu.int/en/ITU-T/techwatch/Pages/video-games-standards.aspx

[36] MIT, The Education Arcade: *Moving learning games forward.* 2009, http://education.mit.edu/papers/MovingLearningGamesForward_EdArcade.pdf

[37] Codecademy, http://codecademy.com/

Box 2: Khan Academy

Image: Salman Khan (right) and Bill Gates in 2011, photo by Jurvetson (flickr), CC BY 2.0.

Not-for-profit Khan Academy[38] started when its creator, Bangladeshi American Salman Khan, uploaded a few calculus video clips to YouTube for the purpose of remotely tutoring some relatives and friends. The popularity of those videos made him realize that he could help others learn, and so he did. Extensive media coverage[39], praise by Bill Gates[40] and a TED talk in 2011[41] helped secure funding to keep the lectures free and to develop a web-based exercise, assessment and reporting tool for learners, parents and teachers.[42]

Khan's short videos are crude, yet effective. The video library now contains some 2,700 clips in different languages and has enabled millions to gain a better understanding of mathematics and other disciplines. While Khan is not a teacher by profession, it is safe to say that he has taught more students than most teachers ever have or ever will. Khan's academy is often associated with the notion of a "flipped classroom": a term coined to describe inverted traditional teaching methods where instruction is delivered online and *"homework"* is moved into the classroom.[43]

[38] Khan Academy, http://www.khanacademy.org/

[39] USA Today: *Need a tutor? YouTube videos await.* 12 December 2008, http://usatoday.com/news/education/2008-12-11-youtube-tutoring_N.htm; SFGate: *Salman Khan, math master of the Internet.* 14 December 2009, http://www.sfgate.com/business/article/Salman-Khan-math-master-of-the-Internet-3278578.php; and Wired: *How Khan Academy Is Changing the Rules of Education.* 15 July 2011, http://wired.com/magazine/2011/07/ff_khan/

[40] Businessweek: *Salman Khan: The Messiah of Math.* 19 May 2011, http://businessweek.com/magazine/content/11_22/b4230072816925.htm

[41] TED: *Let's use video to reinvent education.* TED Talk by Salman Khan. March 2011, http://ted.com/talks/salman_khan_let_s_use_video_to_reinvent_education.html

[42] Khan Academy, http://khanacademy.org/exercisedashboard

[43] The Economist: *Electronic education - Flipping the classroom.* 17 September 2011, http://economist.com/node/21529062

4. Teacher tech and classroom management

A number of other tools are available to present and keep track of educational content, structure courses, monitor class enrolment and evaluate the learning process and progress. Four of these resources for education management are briefly described below.

FrontlineSMS

While many of these tools are web-based, SMS messages, 160 characters short, can be used to provide learning and evaluation support to educators. FrontlineSMS, the popular open-source software able to turn a laptop into a fully-fledged SMS communications hub, has recently launched a fork to help *"schools, trainers, and educators increase knowledge retention, facilitate long-term changes in behavior, and, ultimately, improve the quality of education and training in the last mile."*[44]

Moodle

Moodle is a free learning-management system, widely used by distance learning programs[45] including the ITU Academy.[46] Features such as assignment management, grading and quizzes facilitate communication between teachers and students. Interoperability is a great advantage of the software and ensures scalability and extensibility. A community of programmers is developing new modules to increase Moodle's functionality and to adapt it to users' respective needs.

Piazza

Piazza is an interactive Q&A website where students pose questions related to offline courses, which peers and educators then respond to.[47] The best responses from peers are endorsed by instructors, allowing this social-networking website for homework to replace overcharged email reflectors; avoiding repetitive questions/answers and encouraging active student participation.[48]

Interactive Whiteboards

Interactive whiteboards combine both software and hardware components (large interactive display, projector, computer) and have replaced traditional chalkboards in many developed-world classrooms. Recognizing and capturing user input and interaction are some of the features supported by interactive whiteboards. In part, this is realized through electromagnetic, optical and ultra-sonic technologies that can be found in other consumer electronics (screens, video consoles, etc.). Learning resources dedicated to use on interactive whiteboards can be found online; some for free, and some available for purchase or on a subscription basis. Once the learning resources are available locally, interactive whiteboards can be operated without an Internet connection.

[44] FrontlineSMS, http://learn.frontlinesms.com/

[45] Moodle, http://moodle.org/

[46] ITU Academy, http://academy.itu.int/

[47] Piazza, https://piazza.com/

[48] The New York Times: *Homework Help Site Has a Social Networking Twist.* 3 July 2011, http://nytimes.com/2011/07/04/technology/04piazza.html

For instance, Open-Sankoré is a free open-source software for interactive whiteboards, offered alongside an associated resources platform, and promoted by the "Inter-ministerial Delegation for Digital Education in Africa" of the government of the French Republic.[49] Such an availability of interfaces using open standards reduces cost, drives scalability, extensibility and innovation, and constitutes an important factor stimulating the adoption of learning technologies.

Figure 3: Students learning on interactive whiteboard

Source: SMART Technologies, http://smarttech.com/

[49] Open-Sankoré, http://open-sankore.org/

5. How well are trends in ICT in education reflected in technical standards?

Standards enable the interoperability, extensibility and reusability of ICT resources and tools; features crucial to a meaningful implementation of ICT in education. A good starting point in researching existing learning technology standards is the repository maintained by the European Committee for Standardization (CEN).[50]

Learning technology standards do not include instructional design, pedagogical norms, cultural conventions, learning objectives or specific learning content, but rather address:

In 2005, ITU's Telecommunication Standardization Sector (ITU-T) published a standard to support a multimedia framework for distance learning services. The standard, Recommendation ITU-T F.742, describes application scenarios of distance learning and deduces general requirements to be met by distance learning services.[51] A simplified functional model is proposed (see Figure 4), which is composed of learning resources on one side, learners on the other, and a digital learning service platform (DLSP) in-between.

Figure 4: Functional model of distance learning services

Source: Figure 2/Recommendation ITU-T F.742, http://itu.int/ITU-T/F.742

[50] CEN Learning Technology Standards Observatory, http://cen-ltso.net/

[51] ITU: *Service description and requirements for distance learning services.* Recommendation ITU-T F.742, September 2005, http://itu.int/ITU-T/F.742

Given its simplicity, the model can accommodate different modes: such as interactive or non-interactive, real-time or non-real-time learning processes and methodologies, including the traditional teacher-centered learning, individual instruction, self-paced learning, and multi-role and team-based learning.

The category or type of equipment used by learners is not further specified, but the standard points out that the DLSP should offer learners the option to change seamlessly between different equipments while learning. According to ITU-T F.742, a DLSP should (optionally) combine the functions of a videoconference system, an on-demand audiovisual system and a Web-based system, delivering services of acceptable quality and with adequate security.

ITU's Focus Group on Innovation is maintaining a living list of emerging ICT products and services, some of them addressing the needs of the teaching and education sector.[52]

ISO/IEC JTC1 Subcommittee 36 is dealing with standardization in the field of information technology for learning, education and training to support individuals, groups or organizations. Some 30 technical standards and reports cover aspects of vocabulary, content packaging, metadata for learning resources, accessibility and adaptability, nomadicity and m-learning.[53]

The IEEE Learning Technology Standards Committee is chartered to develop technical standards, recommended practices, and guides for learning technology. The committee's scope includes the object metadata, competency data and resource aggregation.[54]

EPUB is a distribution and interchange format standard for digital publications and documents based on Web standards such as XHTML, CSS and SVG. Developed by the International Digital Publishing Forum, and adopted in many e-readers, the standard offers consumers interoperability between software/hardware for unencrypted digital books.[55]

The Advanced Distributed Learning (ADL) Initiative is sponsored by the Office of the Under Secretary of Defense for Personnel and Readiness, United States Department of Defense.[56] Its main output is SCORM, a "Sharable Content Object Reference Model". SCORM is a collection of standards and specifications for web-based learning and governs the communication between online learning content and learning management systems.[57] Part of ADL's work has been adopted by the aforementioned Subcommittee 36 in the form of Technical Reports.

Last, but by no means least in this non-comprehensive list of standards activities, is the IMS Global Learning Consortium; a community of educational institutions, government organizations and equipment vendors developing interoperability standards and supporting such standards' adoption to ensure that the "learning impact" of technology-enabled innovation is achieved globally.[58] The wide range of member organizations may explain the consortium's broad scope of work, which covers areas spanning from ICT accessibility to meta-data and file formats for interactive whiteboards. Some of the specifications have been adopted by Subcommittee 36. A framework for integrating rich learning applications (tools) with platforms like learning

[52] ITU-T Focus Group Bridging the Gap: From Innovation to Standards, http://itu.int/en/ITU-T/focusgroups/innovation/ (participation is open to ITU members and non-members)

[53] ISO/IEC JTC1 Subcommittee 36, http://www.sc36.org/

[54] IEEE Learning Technology Standards Committee, http://www.ieeeltsc.org/

[55] International Digital Publishing Forum, http://idpf.org/epub

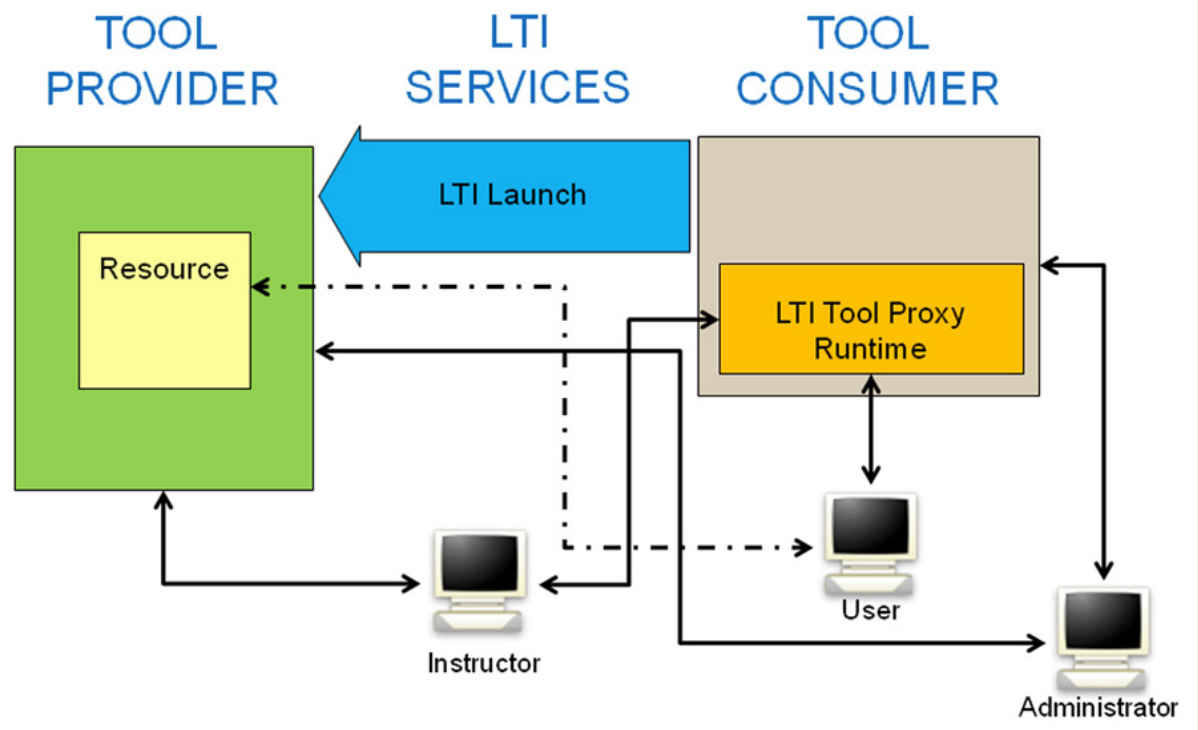
[56] Advanced Distributed Learning Initiative, http://adlnet.gov/

[57] Rustici Software: *SCORM explained.* http://scorm.com/scorm-explained/

[58] IMS, http://imsglobal.org/. IMS originally stood for Instructional Management Systems, but the term was dropped and now only IMS is used.

management systems, portals, or other systems from which applications can be launched (tool consumers) is described in the consortium's Learning Tools Interoperability (LTI) specification (see Figure 5).[59] Moodle (tool consumer) and Piazza (tool) are among the organizations to have implemented LTI version 1.0 and have received the IMS conformance mark.[60]

Figure 5: Learning Tools Interoperability block diagram



Source: IMS, http://imsglobal.org/toolsinteroperability2.cfm

[59] IMS, http://imsglobal.org/lti/

[60] IMS, http://imscert.org/

6. Conclusion

Education and training help pave the way to a successful and productive future. ICTs are important, but are certainly not the only piece in the complex education puzzle seeking to achieve better, more efficient and more affordable education to an ever-growing number of people; especially those traditionally excluded from formal education, be it for economic, social, geographical or health-related reasons.

The field of ICT in learning includes hardware, software, services and media – making it difficult to define its exact boundaries. We consistently witness new launches of innovative products and services based on mobile and Web technologies, and these innovations encompass open and proprietary, not-for-profit and for-profit models, originating with people and organizations from both within and outside the education sector. Multimedia, collaboration, user-friendly interfaces and other features of social-networking websites are key components in these products. User-generated content takes an important place alongside "professional" or "traditional" educational resources. As in other domains that have witnessed or are witnessing the adoption of ICT, this can result in resistance and stigma. This should be met with openness, inclusion, and ICT-aware education policies and strategies.

Openness, inclusion, policy and strategy also play central roles when it comes to developing global standards. Interoperability, extensibility and reusability enabled by standards are indispensable in tapping the full potential of ICT in education and to tackle the significant challenges faced by today's education systems. To realize ICT in education's benefits to learners, educators and society as a whole, collaboration and stakeholder engagement will be crucial to identifying emerging learning technologies and developing standards, technical guidelines and implementation policies.

In addition to learning-specific standardization activities, we have described general standardization activities which drive growth in technology-enabled learning and bear responsibility for many innovative products and services, particularly in areas related to mobile technologies and video. Of similar importance are accessibility, security and privacy aspects, and considering the rapid spread of learning technologies, standards activities dealing with these aspects would do well to include education and learning as valid use cases in their respective work programmes.

Existing ITU-T distance learning standards would benefit from an update and review by users and providers of learning resources. Additionally, a successful inclusion of ICT in a country's education system will occur only if implemented through well-crafted standards, policies and strategies. National administrations and education ministries of the developing world must play a central role in the standardization process if we are to address the current disconnect between the development and implementation of educational technologies. Technical standards will certainly form an integral part of national or regional ICT-in-education policies; but in order to achieve lasting positive impacts, it is absolutely essential that we partner technical standards with standards or best practices in training populations in the implementation, use and maintenance of educational ICTs.

ITU-T Technology Watch surveys the ICT landscape to capture new topics for standardization activities. Technology Watch Reports assess new technologies with regard to existing standards inside and outside ITU-T and their likely impact on future standardization.

Previous reports in the series include:

Intelligent Transport Systems and CALM
ICTs and Climate Change
Ubiquitous Sensor Networks
Remote Collaboration Tools
NGNs and Energy Efficiency
Distributed Computing: Utilities, Grids & Clouds
The Future Internet
Biometrics and Standards
Decreasing Driver Distraction
The Optical World
Trends in Video Games and Gaming
Digital Signage
Privacy in Cloud Computing
E-health Standards and Interoperability

http://www.itu.int/ITU-T/techwatch

Printed in Switzerland
Geneva, 2012
Photo credits: Shutterstock®