**Proposed W3C priorities for education**

**The current state of the ed-tech market**

There has been considerable recent interest in the potential of digital technology to transform education. While the OECD’s PISA reports have focused attention on the underperformance of many Western education systems, Massive Open Online Course (MOOC) platforms in the US have held out the prospect of scaling what have previously been regarded as elite courses, to make them accessible to motivated learners across the world.

There are now good reasons to believe that genuinely useful ed-tech is about to emerge. Mobile technology has recently made 1:1 device ratios attainable in the classroom, the cloud has made it easy to acquire and manage new applications, and touch screens have enabled the development of software that is intuitive to use. Recent improvements in HTML allow for the development of richly interactive online learning experiences. The power of modern technology to process big data, already being demonstrated in business environments, has the potential to help manage complex educational processes.

Against this background, W3C has convened a working group to consider how it can support these widely anticipated developments—because there is still no reliable evidence that useful ed-tech has yet emerged. A 2012 government-funded meta-analysis by the UK’s University of Durham concludes that “the correlational and experimental evidence does not offer a convincing case for the general impact of digital technology on learning outcomes”.

We suggest that there are three key barriers to the emergence of a dynamic ed-tech market:

1. The lack of interoperability of systems and content that would allow different sorts of instructional software to work together in an integrated environment.
2. The lack of discoverability of innovative new products.
3. The institutional conservatism of many state-run education systems, which are often resistant to innovation and uncomfortable with the use of data as a management tool.

We believe that W3C is ideally placed to help to remove the first and second of these barriers. It has both the standing and the technical expertise required to create authoritative standards. As the steward of the worldwide web, it is closely identified with the benefits of connectivity. The sense of moral purpose often associated with the worldwide web gives it the stature required to lead an important initiative for the improvement of global education. At the same time, it will need to work with governments that are prepared to address the institutional conservatism to be found in their own formal education services.

**The requirement for ed-tech**

Education technology is not just about publishing. It is a common aphorism amongst teachers that “we learn by doing”. From this perspective, the role of the teacher is to design instructional activities that are appropriate to a given set of educational objectives, to motivate students to undertake those activities, to provide feedback on their performance, and to manage their progression from one activity to the next.

Digital technology has proved well adapted to managing complex processes and transactions in other businesses. Analytics software has shown that it can make sense of complex datasets. Digital games routinely support the sorts of rich interactivity that education requires at the instructional level. Yet none of these paradigms have been widely implemented in education, which still depends on the uncertain craft of the individual teacher, in a profession which in many subjects faces a chronic undersupply of well-qualified staff.

Most education technology to date has concentrated on the dissemination of information and on assuring the memorisation of such information through simple multiple choice tests. There has been recent interest in the potential of social networking technology, though it is not clear that this will make a significant contribution in schools (K-12), where (in contrast to professional development) students have limited expertise in the subject being studied.

Little has been done to develop education-specific software which:

* at the instructional level supports purposeful interactivity (both on and off the computer) in a manner analogous to digital games;
* at the learning management level, controls assignment, the sequencing of activities, reporting, analytics and accreditation.

Good data interoperability, especially between the learning management systems and the instructional content, is an essential prerequisite for the successful development of either class of software.

***Such interoperability standards do not currently exist. If they are not developed soon, it is likely that control of an emerging ed-tech market will be captured by proprietary platforms.***

**SCORM: a lesson from the past**

The Shareable Content Object Reference Model (SCORM) was a collection of informal standards published by Advanced Distributed Learning (ADL), a unit of the US Department of Defence. Two significant versions were produced: SCORM 1.2 in 2001 and SCORM 2004. The standard included the following components.

* Content packaging, a specification developed by IMS Global Learning Consortium (IMS GLC), comprising an aggregation of zipped content. The compressed folder included an XML manifest file, which provided a “substrate” for other types of metadata (such as LOM and Simple Sequencing).
* Learning Object Metadata (LOM). A metadata format standardised as IEEE 1484.12, containing classification information deemed relevant to education.
* Computer Managed Instruction (CMI): a data model inherited from the Aviation Industry Computer Based Training Committee (AICC), specifying the runtime data that a Shareable Content Object (SCO) might want to read and write to and from the LMS by which it had been launched. This included contextual information read from the LMS at launch, and learning outcome data reported back to the LMS at termination.
* The SCORM API, a JavaScript API providing the means by which runtime data was passed.
* Technical metadata, which in the case of SCORM included a single field in the content packaging manifest called ScormType. This could equal either “sco” (meaning the webpage used the CMI runtime) or “asset” (meaning it did not).
* Simple Sequencing, an IMS GLC specification which allowed the SCOs contained in the package to be adaptively sequenced by the LMS.

SCORM achieved significant global traction in the education world between 2001 and about 2006. After this, interest waned for the following reasons.

* Legal disputes between ADL and IMS GLC over intellectual property rights restricted the development of the Content Packaging specification.
* Developments in browser security rendered the JavaScript API obsolete.
* Simple Sequencing failed to provide robust, plug-and-play interoperability.
* The CMI runtime provided no support for multi-player interactions.
* The CMI runtime data model was not extensible and did not, for example, support the transfer of creative product (such as essays or solutions to problem).
* There was no attempt to represent learning objectives (important both for adaptive sequencing and the reporting of learning outcomes) in a manner that were comprehensible outside the context of a particular course.
* SCORM was frequently specified in government procurements in circumstances which encouraged suppliers to produce the simplest possible implementations, generally avoiding use of the runtime. This undermined the reputation of the SCORM brand.

Recognising that it was not well placed to steward a *de facto* global ed-tech standard, the US DoD attempted in 2008 to transfer ownership of SCORM to a new non-profit organisation called LETSI. A conference was held to which over 100 white papers were submitted with proposals for improvements to the specifications. However, the transfer of ownership was prevented by legal challenges by IMS GLC, which owned IP rights in Content Packaging and Simple Sequencing.

The only substantive development to emerge from LETSI’s work was TinCan, also known as the Expererience API (xAPI). Based on a LETSI prototype, this project was subsequently funded by ADL. TinCan updated the SCORM API to provide a modern transport protocol based on Web Services. It includes only a rudimentary data model and does not cover launch, metadata description or the sequencing of content.

**Recommendations for action by W3C**

W3C is well placed to create the “next-generation SCORM” which the LETSI initiative failed to provide in 2008. Such an initiative would address education’s requirement for purposeful activity integrated with analytics and process management.

Such an initiative would fall within the scope of the worldwide web, so long as this is understood as a vehicle for providing data connectivity and not merely a medium for the distribution of content. Such a service for connectivity must not seek to restrict the type of applications it supports. It must be accessible to desktop and mobile apps as well as to web apps. This should not be seen as problematic because the key to preventing the capture of an emergent ed-tech market by proprietary interests is open runtime data, not necessarily open file formats.

We recommend that such a W3C initiative should adopt the transport mechanism provided by TinCan, adding the following components to complete a viable standards platform for education.

* A simple but consistent method of publishing metadata for learning content, supporting both discoverability and the declaration of runtime functionality.
* A data model description language which will enable supplier communities to specify new data structures in a consistent and extensible manner, allowing for the development of new metadata and runtime data models in a timescale that mirrors product innovation.
* A new specification for the adaptive sequencing of learning content.
* A specification for the machine-readable description of learning objectives and curricula.
* A machine-readable data handling description language, allowing for the specification of procedures for data protection and privacy. Such a specification will allow governments and other institutions to produce consent forms, regulatory standards and legislative instruments in ways that software, sold on an international market, can easily understand and support. The precise definition of such procedures would also support an informed public debate on these issues. Without greater clarity in this area, it is likely that the sharing of educational data will run into serious political obstacles.

Taken together, these specifications would form a coherent and viable platform to ensure the interoperability of educational data. Subsequent work could deliver convergence with open content formats, such as EDUPUB or IMS GLC’s Question and Test Interoperability (QTI), which can be supported on a case-by-case basis.

When ed-tech achieves significant impact on learning outcomes, the need to ensure equitable access to those technologies will become increasingly urgent. Viable technical solutions to this problem will depend on the ability of management systems to pass student preference data to instructional software. Such a solution will be enabled by the educational data interoperability platform outlined above.

Alongside such technical work, W3C will need to seek partnerships with interested Departments of Education, which will have an important role in encouraging demand within their various jurisdictions for innovative and effective education technology that supports open data standards.

Crispin Weston & Pierre Danet
17 February 2015