Tech., Inst., Cognition and Learning, Vol. 7, pp. 205–224
Reprints available directly from the publisher
Photocopying permitted by license only

A New Generation of Learning Technology Standards

ROB ABEL*

IMS Global Learning Consortium

This paper considers some of the factors that affect learning technology specifications and standards development and how they have changed in 2010 versus 1995. Three factors are considered: The evolving learning technology standards development environment; the state of mainstream adoption of learning technology; and the context of global education and learning challenges. The analysis concludes that learning technology standards activities could benefit going forward by establishing a better linkage between research and market needs; encourage greater active participation of industry leading suppliers; leveraging an expanded set of end-users; and connecting standards activities to large scale improvements in access, affordability, and quality of learning. A new body of work called Digital Learning Services standards is contrasted with previous results as an example of how some of these changes can be realized in interoperability activities in the future.

Keywords: Learning, education, interoperability, standards, specifications, IMS Global Learning Consortium, Common Cartridge, Digital Learning Services, Learning Tools Interoperability, LTI, Learning Information Services.

INTRODUCTION

Since the mid-to-late 1990's suppliers, researchers, and government organizations have participated in the development of interoperability specifications and standards for learning and educational technology. Has this work played a major role in the progress that has been made in using the Internet to support or enhance learning? What role will interoperability play in the future of learning and educa-

*Corresponding author: rabel@imsglobal.org

tional technology? As we near the year 2010 having almost 15 years experience of exploration, experimentation, and in some cases, formalization of learning technology standards, it is a good time to assess the directions interoperability and standards might take from here.

This paper considers some of the factors that affect learning technology specifications and standards development and how they have changed in 2010 versus 1995. The first factor considered is the evolving learning technology standards development environment, namely the interplay among researchers, suppliers, and government. The second factor considered is the state of mainstream adoption of learning technology to understand the new base from which progress will now proceed. The third factor considered is the context of global education and learning challenges and the role of technology in addressing them. Finally, the paper summarizes how the influence of these three factors point the direction for future interoperability activities to bring together the interests of researchers, suppliers, and government.

THE LEARNING TECHNOLOGY STANDARDS ENVIRONMENT

It is important to understand that interoperability solutions will emerge and evolve in a marketplace with or without standards organizations or formal standards activities. For instance, there is a great deal of standardization in how to operate an automobile around the world. Yet, there has been no standardization activities or organizations required to achieve this. Interoperability solutions are created because markets are self-modifying, dynamic systems that solve problems in order to survive and grow. As markets scale, interoperability is a necessary problem to overcome as a market drives toward efficiency.

Why then did several standards organizations come into existence focused on learning and educational technology in the mid to late 1990's? At least three reasons were apparent:

1. Supplier organizations believed that by creating standards they could cooperate to develop the future market opportunity in e-Learning
2. Research organizations perceived the standards venue as a way to collaborate with like-minded pioneers in developing new approaches to support learning with technology, with standards being an important by-product
3. Government organizations wanted to encourage standards development in order to increase market efficiencies and choice in procurement of learning platforms and digital content

While these three objectives are compatible to some degree, each has its own specific emphasis. Supplier's primary objective is market growth. Researcher's primary objective is to further scientific understanding. Government entity's primary objective is cost savings. The differences in emphasis can be a source of tension. Perhaps the greatest tension is between researchers and suppliers. While researchers are interested in proving innovation, suppliers are interested in achieving mainstream market adoption. The problem, of course, is that something that is very innovative, for example, learning objects, may require a change in behavior that is a barrier to mainstream market adoption. The utility in this idea to suppliers may then prove to be rather limited in developing the market.

There are many standards organizations and activities all over the world in many different fields that all experience interplay to some extent among suppliers, researchers, and government. However, in learning and educational technology this interplay is greater than in most. Whereas the majority of standards activities tend to be dominated by suppliers, educational and learning technology standards activities have evolved to include strong educational institution and government influences. This has been partly due to the fact that some of the organizations created originated in academia, such as the IMS Global Learning Consortium (IMS GLC).[1] But, the evolution of the market has also contributed to this as described further here.

The learning technology standards landscape in the late 1990's had very healthy participation from a large set of suppliers eager to capitalize on the nascent market for learning technology and, in particular, e-Learning. There was also strong interest and involvement from various research organizations around the world, primarily coming from the higher education segment, but not exclusively. Government entities started playing a larger role large in the decade, led by the Advanced Distributed Learning (ADL) Initiative under the U.S. Department of Defense.[2]

However, as the Internet bubble burst in 2000-2001 the prospects for learning technology and e-Learning suppliers were diminished with a majority going out of business and consolidating into a relatively small number. In addition, the needs of the various segments, corporate training, higher education, and K-12 education diverged into separate paths. Large diversified suppliers, such as Oracle, Microsoft, Adobe, Sun Microsystems, Cisco, IBM, and Apple, realized that the e-Learning opportunity was a niche, not worthy of significant investment and involvement in standards activities. As a result, the supplier drive toward standards was greatly

[1] For background on IMS GLC, see < http://www.imsglobal.org/background.html >

[2] See the ADL web site < http://www.adlnet.gov/ >

reduced from 2002 onward. But, the Internet bubble had little impact on the ADL and their primary activity, SCORM (Shareable Content Object Reference Model).[3] It also had relatively little impact on the research activities into e-Learning innovation. Universities and their sponsors were continuing to invest in research activities.

The net result was a set of standards activities that roughly separated into two tracks. The first was led by SCORM, which suppliers were obligated to follow and implement in order to achieve procurement compliance, but had relatively

TABLE 1
Leadership of major interoperability standards activities 1999-2005.

Learning Tech Standards Area Description	Leadership and Primary Standards Organizations Involved
Scoring, sequencing, and tracking of computer-based learning for computer managed instruction- Enabling a learning management software application to route a learner through digital content from multiple content providers	Suppliers (early) & SCORM (later)- AICC[4]
Learning resource metadata- Enabling the cataloging, searching and possible combination of small topics of learning (sometimes referred to as learning objects)	Researchers– IMS GLC & IEEE LTSC[5]
Packaging of learning content- Enabling any application (such as an authoring tool) to specify the organization of content (with features typical of learning content) that can be exported to and understood by any other application (such as a learning management system)	Suppliers (early) & ADL SCORM (later)- IMS GLC
Question and test interoperability- Enabling use of test banks across a wide variety of assessment and learning management systems	Suppliers (version one) & researchers (version two)– IMS GLC
Learning design- Enabling machine-readable descriptions of collaborative learning activities and pedagogy so that they can be specified and replicated	Researchers– IMS GLC
Shareable content objects for self-paced online learning- Enabling a learning management software application to route a learner through granular digital content (sometimes referred to as learning objects) from multiple providers	SCORM- ADL

[3] Information on SCORM can be found at <http://www.adlnet.gov/Technologies/scorm/>
[4] <http://www.aicc.org/ >
[5] < http://www.ieeeltsc.org >

Learning Tech Standards Area Description	Leadership and Primary Standards Organizations Involved
Learner information profile for ePortfolio & accessibility- Enabling description of a learner's progress, preferences, and capturing of artifacts providing evidence of learning	Researchers– IMS GLC
Course enrollment information exchange- Enabling learning applications to obtain data about course enrollments from administrative systems	Suppliers (early) & researchers (later)- IMS GLC
Tools launch and data exchange- Enabling one learning application, such as a learning management system to launch and exchange data with an external "tool" such as an assessment system	Researchers– IMS GLC
Resource list exchange- Enabling exchange of lists of electronic educational resources	Researchers– IMS GLC

little interest in driving. The second was led via a range of research activities coming from higher education. Table 1 summarizes ten major areas of interoperability standards development in the 1999-2005 timeframe, indicating where the primary leadership came from and the primary standards organizations involved.

From this period to the current time some additional developments have occurred. The various learning technology supplier segments have recovered to some degree from the bursting if the Internet bubble, albeit in a consolidated state, but stabilized considerably.

- In the corporate training segment, learning management systems and prepackaged digital content has remained a small niche, but there is a very large market for custom-developed content among training departments from large organizations around the world. Standards areas such as content packaging and scoring, sequencing, and tracking of computer-based training content and reusable learning objects have helped to support the needs of the custom content segment.
- In higher education, e-Learning as a delivery mechanism has gone from a very small percentage of students to affecting 20% or more in some regions.[6] Online divisions of for-profit higher education providers and departments in non-profit education providers have achieved great success. Course management systems using a variety of the standards areas detailed in Table 1 have played

[6] For instance, for U.S. data see I. Elaine Allen and Jeff Seaman, *Staying the Course: Online Education in the United States, 2008* (Needham, Mass.: Sloan-C, 2008), <http://www.sloan-c.org/publications/survey/pdf/staying_the_course.pdf>

a major role in enabling the pervasiveness of online and blended learning in the higher education segment.
– In the K-12 segment there have been some national projects that have shown the utility of online tutoring and educational resource sharing, as well as a significant growth in the number of virtual schools to support non-traditional delivery of education. In both the higher education and K-12 segments the blending of delivery strategies involving the use of classroom and online technology has become an expectation of many students, used to living in the Internet era.

The net-net of these developments is a standards development environment today that is could be characterized as follows:

– A body of existing standards work that may be overly biased towards the interests of researchers
– A smaller set of more stable suppliers who have not been engaging that actively in standards activities, but could get interested to the degree they see direct benefit

MAINSTREAM ADOPTION OF LEARNING TECHNOLOGY

In the mid-1990's the aspirations were that the Internet would soon enable transformation to a new era of learning. Many were convinced that a key component to this transformation would be development of and access to granular "learning objects" tagged with descriptive meta-data that would allow access of the right piece of content at just the right time. Many entrepreneurs from large and small corporations, governments, and institutions alike were certain that the "Netscape of Learning" could not be far off and that a new category of learning platforms, both enterprise-based and Internet-based, would emerge. The "learning management system (LMS)" concept was born. The name LMS took hold as a sort of generic container that includes systems perhaps more aptly named, such as Course Management Systems (CMS), Virtual Learning Environments (VLE), and Instructional Management Systems (IMS). Most agree that the systems that have emerged do not "manage learning." What they do is address various administrative, organizational, and distribution tasks associated with learning. Those systems most frequently referred to as an LMS are typically in the corporate training realm, and are really "learning administration systems" at best. Some do attempt to classify and sequence the aforementioned learning

objects at some level. However, such systems, with features such as "precision learning tracks," already existed prior to the Internet becoming the primary delivery network. The productive use of learning objects, has arguably come more from their role in authoring or configuring content, i.e. production, than in the facilitation of learning.

If the vision of "learning objects" has not yet transformed learning, what has? Well, as in most technological evolution, there have been relatively few breakthroughs, but several important pragmatic gains. There are three elements of learning technology that have become "mainstream" since the mid-1990's:[7]

- First, classrooms and campuses have continued to incorporate more and more technical infrastructure in terms of networks, Internet connections, interactive white boards, classroom management systems, etc. While not always finding a good pedagogical fit, technology is slowly but surely enabling electronic media to become dominate in the teaching setting.
- Second, some form of "learning management system," such as the course management system, in the educational context, have been widely adopted, providing an online communications hub for posting of class materials, syllabi, etc. The variation on this theme in the corporate training segment has been systems that help to provide a single point of access to online learning materials and "track" access to or completion of these materials at some level.
- Third, online courses, programs, etc. have largely replaced older alternatives for delivering distance learning that were less interactive and less timely. This has enabled education at a distance to be scaled up considerably with the new model appealing to a much broader audience than the older correspondence model.

It's important to point out that these mainstream developments that have taken hold have not required major changes in behavior. They have enabled instructors and learners to be more efficient in things they were already doing. Because the Internet has not revolutionized education in this time period, some researchers have gone as far as to declare e-learning a "bust."[8] But as Peter Drucker pointed out, the information revolution, like the industrial revolution two

---

[7] Rob Abel, "What's Next in Learning Technology in Higher Education?" (October 18, 2005), available at <http://www.imsglobal.org/articles/index.cfm>

[8] For instance, see Robert Zemsky and William F. Massy, "Why the E-Learning Boom Went Bust," *Chronicle of Higher Education,* July 9, 2004.

centuries earlier, has not changed what we do with information but, rather, how we do it. Drucker noted that the first fifty years of both revolutions saw improvements in efficiency of existing processes in numerous areas, as opposed to true breakthroughs.[9] The progress in learning systems in the last ten years represents solid technological innovation that is here to stay and to build from.

Much has been made in recent years about the difference between "digital natives" and "digital immigrants." Digital natives are indoctrinated at an early age to using electronic devices of various types, cells phones, computers, etc., in all aspects of their lives. As such, they see these devices as tools and ascribe to them no special status as "technology" per se. Nowhere is the contrast between digital natives and immigrants greater than in some education scenarios, where an older generation of teachers or professors instructs a younger generation of "traditional" students.[10] For instance, surveys by EDUCAUSE, have indicated that while professors may see themselves as blazing new ground by using advanced technologies in the classroom, the students just want them to do what makes sense and is effective, whether incorporating technology or not.[11] In other words, the natives "just want to get the job done" and give no special status to technology.

In the mid-1990s, when the push for Internet-supported learning and associated interoperability standards began in earnest, many of those leading the charge had more expertise in computers or technology than in learning. There were at least four reasons for this:

- Many new ventures came from technology companies looking to cash in on a new market opportunity.
- There were a relatively small percentage of educators with a real stake in where these new developments were heading, as it just was not part of the daily priorities yet.
- As is still true today, the "science of learning" is a young field, and the qualifications for staking a role in this new territory were pretty loose.
- Historically it seems that technology usually diffuses from outside the domain of education or training into it, rather than the other way around.

---

[9] Peter F. Drucker, *Managing in the Next Society* (New York: St. Martin's Press, 2002), 5–11.

[10] "Traditional students" is used here to contrast with older students pursuing additional education beyond the age of 23 years or so.

[11] See Robert Kvavik, "Convenience, Communications, and Control: How Students Use Technology," chapter 7 in *Educating the Net Generation*, ed. Diana G. Oblinger and James L. Oblinger (Boulder, Colo.: EDUCAUSE, 2005), e-book, <http://www.educause.edu/educatingthenetgen/>

At a recent UNESCO meeting in Europe a presenter highlighted a project in a disadvantaged region of Africa where a commercial vendor donated some high-end telecommunications equipment for the classroom. The presenter chided the experiment, as the equipment remained unused, clearly a poor fit for the setting. However, this example from Africa is not significantly different from similar outcomes in the richest of continents and regions. If the technology does not fit the learning activities, it will not be used. And, finding the pedagogy that fits challenges us to go beyond our understanding of learning science to date. While this notion of fitting technology to supporting learning activities is very common sense to learners and educators, it many times can elude technologists.

It is clear that as we look at the mainstream successes for learning technology so far, the focus needs to be on using technology to support and enhance "getting the job done" with respect to learning and education. This drives adoption. After all, even those who are most comfortable with technological change, the digital natives, are telling us that. For standards to be effective, we must therefore ask ourselves, "How can we help to get the job done?" In other words, where can technology best impact learning and how do standards support that evolution? Most importantly, is the proposed use of technology actually going to help achieve improved learning experiences in practice based on the needs of learners and educators? Educational approaches that technology can enable might "sound good" for some future world, but do not deal with the realities of "how the job gets done today." This does not mean that research in approaches that require behavioral change will not bear fruit. Over the long run, behaviors can and do change. But, researchers can be advised to consider how their breakthrough ideas can cross over into the mainstream by making life easier on teachers and students first and then subtly contributing to behavior change over time.

Given what has occurred, how would we predict what new technologies and products will be adopted by the mainstream going forward? Adoption may depend on the introduction and adoption of successful standards, as well as refining the innovations themselves to a high degree of usefulness to educators and students. Figure 1 illustrates a very typical set of new technologies and products that information technology departments are considering to support learning. Today's picture goes way beyond the learning management system.

Standards activities and organizations will be most effective if they can help lay the ground work for innovations most likely to take hold, much as they did manage to help the formation of the learning management system category of products in multiple segments over the last decade. If we compare Figure 1 to the set of standards areas in which significant work has been done in Table 1, we

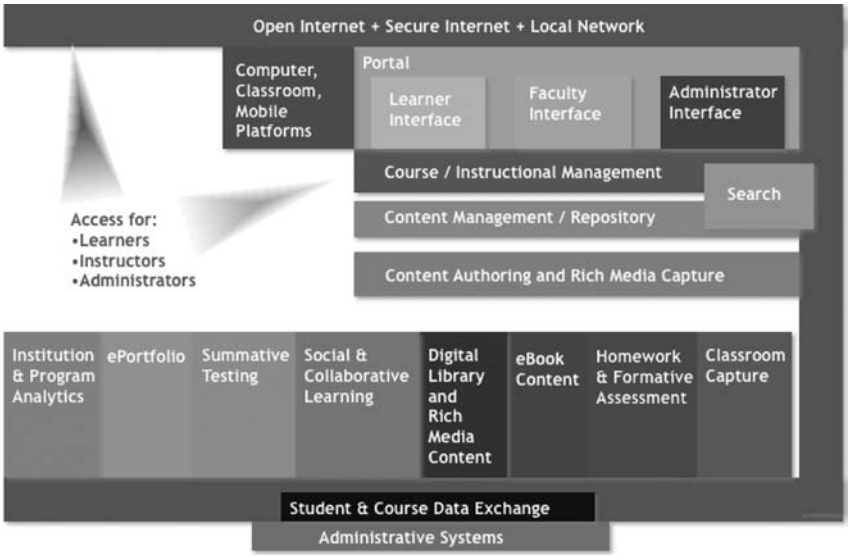

FIGURE 1
Technology and product categories in the learning enterprise.

can see that there is a significant overlap between the areas focused on by standards activities and the emerging technology and product categories. However, while this is true, the following realities of the state of mainstream technology for learning and education should be considered in 2010 as having evolved significantly since 1995:

– Digital content alternatives for learning have evolved significantly beyond the granular learning object concept by encompassing online learning applications that provide not just content, but sophisticated learning environments, and greater online access to electronic books and library resources
– Collaborative learning, assessment, and better capturing of learning outcomes have emerged as significant application categories in their own right – separate from sources of digital content – as was not the case in the 1995 computer-based training model
– Computing platforms have diversified considerably and the need to seamlessly integrate electronic learning across a classroom and online context is becoming paramount for "learning management" to be most effective
– Cloud computing has matured significantly since 1995, creating the potential for a much greater mix of applications and alternative resources to support learning

So, the conclusion with respect to learning technology standards is that the mainstream adoption of learning technology is moving in new directions today, some of which are consistent with past standards focus areas and some of which require new activities. As noted in the prior section of this paper, there has been a lack of strong engagement from suppliers, which exacerbates the challenge of aligning standards activities with market direction.

GLOBAL EDUCATION AND LEARNING CHALLENGES

As we approach 2010, the view on global educational and learning challenges has matured substantially from that in 1995. The connection between educational attainment and economic advancement has been studied extensively and corroborated at national and global levels.[12] As a result, the race in national education attainment in developed countries has received significant attention. Corporate training departments are under growing pressure to respond to increasing globalization, competition, and the need to cost-effectively train their employees as required skills evolve.

However, the challenge remains that historically there has been a tradeoff among access, affordability, and quality of learning and educational experiences. While MIT has made their course materials available online to all,[13] it is a very tiny percentage of the world population that receive an MIT educational experience. The challenge around the world is that current educational systems cannot meet the capacity demands at high levels of quality. Leading institutions and school organizations at all levels are also attempting to leverage technology to help improve the understanding of learning outcomes and how to improve them.

From 1995 to the present time, what role has technology had in addressing this fundamental tradeoff? Technology has had its greatest impact on access to educational resources. Projects such as the MIT OpenCourseware show that technology has a role in increasing access. Many feel that today the tyranny of time and geography with respect to education is moving toward emancipation. Access, choice, and opportunity are becoming more and more available to all. Evidence is apparent in the rapid growth of online and distance learning programs offered from a wide spectrum of universities and colleges and virtual schools, providing more flexible and convenient access to learning experiences. However, access is not

[12] Organisation for Economic Co-operation and Development (OECD), *Education at a Glance: OECD Indicators 2006* (Paris: OECD, 2006), pp. 120-166

[13] <http://ocw.mit.edu/OcwWeb/web/home/home/index.htm>

equal or easy to all educational resources. In some respects it is a societal issue to address this challenge, but it is also a technological issue with respect to the cost of achieving the integration of various mixes of content and applications in the highly accessible online medium. For instance, it is a major challenge to convert course materials developed in one learning platform for use in another—not an uncommon scenario for educators to deal with today. It is also very challenging for an educator to incorporate a favorite learning tool, perhaps podcasting or wiki development, into an integrated set of learning activities.

Impact on affordability of education by technology has been largely a matter of the "cost savings from greater convenience" enabled by Internet-accessible learning experiences. The economic value-add of education credentials has been strong and well documented and has permitted tolerance of price increases in many countries. But the general feeling is that we have approached or are approaching the tolerance for price increases, even in countries that have been market-oriented in their approach. In the corporate education sector there have been well-demonstrated "savings" by reducing the cost of meetings through distributed learning or the costs of materials replaced via simulations. Therefore, return on investment is a matter of determining if the cost of implementation is less than the assumed cost savings. However, more examples of measuring return by achieving improved performance from investment in education, whether credentialed or not, are warranted.

The impact on the quality of educational experiences from technology can be viewed from a couple of different perspectives. One perspective is technology can improve efficiency on rote and mundane tasks, allowing more time for quality instructional interaction. Another is the entire field of assessment in the critical role of helping to ascertain learning outcomes and enable improvement of educational processes in a scalable way. It is also important to note that improved learning outcomes could result from engagement or from more effective instructional activities.

Technology is capable of playing a role in both. However, in the end analysis, we are still in an era where education is considered highest quality if it occurs via access to the best educational resources, especially the best teachers and professors. Our current higher education era is influenced greatly by the push toward research as the pinnacle of prestige and knowledge in the 20th century. It is assumed today that physical presence at the centers of research result in the highest quality education. This means that overall the primary impact of technology to quality of education today goes back to technology's ability to enable access to "high quality" resources. The growth of online and distance offerings are as "high quality" as the institutions (or perhaps individuals in other settings) that create and deliver them.

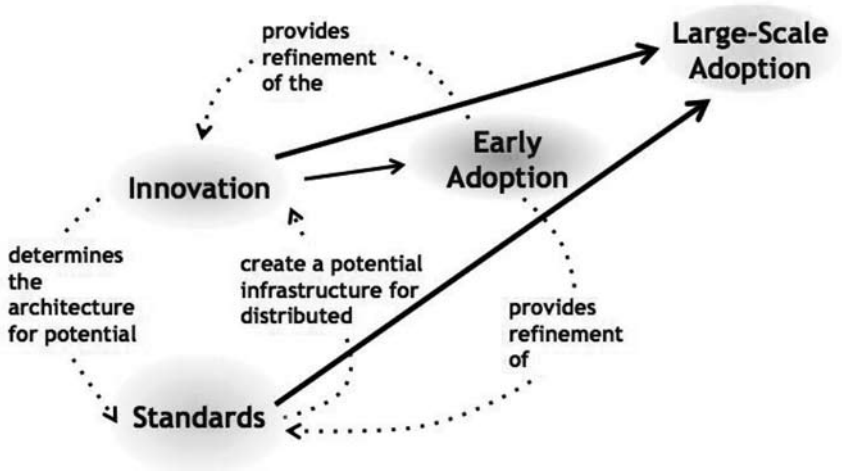

FIGURE 2
The relationship between innovation, standards, and adoption.

Is it possible to connect interoperability standards directly to these core global education and learning challenges of access, affordability, and quality? Impact on global learning challenges involves a need to achieve large-scale or widespread results. Whereas in 1995 we may have envisioned that technology would help breakdown existing barriers to the best educational resources, we were perhaps a bit naïve in our understanding of the relationship between educational value delivered and the required credentialing authorities – which is not something technology can address. However, in 2010 we are seeing the progress of much greater adoption of learning and educational technology by organizations from all sectors around the world. In U.S. higher education, for example, the learning technology specialist is well established and the fastest growing responsibility in information technology organizations.[14]

So, as we move into 2010, we have great opportunity to see research advances, many represented by the standards activities shown in Table 1, to be adopted at large scale and directly influence the major challenges of access, affordability, and quality. As shown in Figure 2, research innovation advises the evolution of potential underlying standards. An innovation to which the market is receptive can, if

[14] Brian L. Hawkins and Julia A. Rudy, *EDUCAUSE Core Data Service: Fiscal Year 2005 Summary Report* (Boulder, Colo.: EDUCAUSE, 2006), 18, 7, 9, <http://www.educause.edu/coredata/reports/2005/>

thought about in the right way, provide a standards architecture that ideally, creates a platform for greater distributed innovation. In the case of learning or educational technology, if the innovation helps make learning and educational processes better, faster, or less costly, there will be adoption of it. Good interoperability standards enable more seamless and lower cost integration of new innovation, helping to overcome these natural barriers and scale to a much wider audience or market. Therefore, whereas one could view the creation of a standard as an important milestone, the effectiveness of a standard can be measured by the role it plays in fostering large-scale adoption and impact on access to affordable, high quality learning and educational experiences.

THE FUTURE OF LEARNING TECHNOLOGY INTEROPERABILITY ACTIVITIES

We have considered thus far in this paper the learning technology standards environment, the mainstream adoption of learning technology, and the world's most pressing learning challenges. On the one hand, the ramifications on the future of interoperability activities related to learning technology may not be earth shattering. However, all three factors indicate the need for some changes going forward. The four primary changes needed may be summarized as follows:

- Establish a better linkage between research-driven standards activities and supplier adoption of standards
- Encourage greater active and deep participation of industry leading suppliers in the interoperability activities
- Leverage an expanded set of end-user communities as voices in the adoption of innovative technologies and the standards that support them
- Connect the research innovations, standards, and market adoption to large scale improvements in access, affordability, and quality

As the learning technology market segments have stabilized they have evolved to a point where the investment of scarce resources into interoperability standards makes more sense. This is a very positive development for interoperability activities. However, the primary challenge that suppliers face today, as noted above, is that they have not been deeply engaged in the development of the existing standards.

As a result, when market participants consider the existing standards for utility in solving the real market challenges, they find something that "kind of fits" but

is not a clear match to their needs. Thus, there is much adaptation of standards that occurs. While this means that the standards have helped, it also means that interoperability is often not achieved due to deviations taken. Thus, it is absolutely essential for standards to play a more significant role going forward to actively engage all three types of participants, but especially the suppliers who are active market participants and play the critical role in adoption.

But, while standards organizations and activities hold great potential, success of standards organizations in practice in a wide variety of domains has been challenged today in the Internet era. For instance, a standards organization, if it has the right participants and process, can accelerate the process of establishing a standard and getting it out to virtually unlimited market participants at a low cost. However, if standards are to capture something that is "tried and true," how can a standard be created and distributed rapidly enough to accelerate change? This is a fundamental challenge in today's markets in which large organizations, such as Google, can publish a freely available interface that quickly becomes a de facto standard because of the originator's market dominance. So, whereas standards organizations have well thought out processes for achieving agreement on standards, does the process take too long to accelerate market development?

Another standards challenge specifically for learning and education technology is whether or not any particular sub-segment of the market has enough resources to create better standards than those that "come in from the outside." Is it simply more efficient to adopt generic web standards that are developed for other reasons but could be applied to learning, education, and training requirements?

So, there are at least the following three major challenges to learning technology standards activities as we approach 2010:

1. Unique market need? Is there a need for a learning technology standard to be developed that solves learning market problems better than the application of existing standards developed for other markets?
2. Sufficient resources available? Is there a critical mass of market participants who are willing to join forces not only to sanction the standards, but also to make change happen in the market?
3. Fastest road to opportunity? Can the standards be developed and fielded fast enough and create more market efficiency in a cooperative model than the alternative of depending on a dominant supplier?

In essence, these three challenges can frame three tests for any standards activity to consider whether or not it will have the intended impact. They can also help

select areas for focus in which the collaboration among suppliers, researchers, and government can be most fruitful.

One of the ways to cut through some of these challenges is for government organizations to play a larger role in standards setting. However, too much government influence can result in a scenario that at first may appear to be positive for standards development but then often turns unproductive. This is the scenario in which standards are perceived as primarily being a checklist item in a procurement as opposed to being something that is creating market opportunity. Such scenarios usually unfold in a regulatory-influenced environment. Some standards development organizations that are closely coupled with the government make it their key objective to achieve such regulation. And, if regulation is required to achieve the ends in mind, it may be completely appropriate. But while this scenario often engenders industry support – as there is literally no alternative – it also can backfire. It backfires because there is typically little incentive for market participants to invest in the standards as they perceive little connection to market opportunity. This disincentive can be made even worse in a situation where the standards do not achieve true interoperability in practice. In such scenarios, suppliers are forced to comply with a checklist standard that does not result in an operational efficiency in practice. The net result is further disincentive for market participants to participate in standards activities.

While it may seem difficult for a standards activity to deal with these significant challenges, success in doing so is readily evidenced by the level of leadership and participation by market participants. Table 2 summarizes some of the key challenges to those involved in development of learning and educational

TABLE 2
Transitioning learning and educational technology standards to the future.

Challenge Area	Today's Standards	Future Emphasis Needed
Focus	Many were created to solve envisioned or research problems	Address critical problems of suppliers and end-users as evidenced by their active participation
Lack of interoperability in practice	Many were research projects that had value as frameworks upon which to create a new product but did not achieve interoperability	Provide application profiles that constrain to the greatest common factor that industry can support
Checklist standards	Mandated by government entities even when they do not significantly improve efficiency	Support industry-driven standards that are self-motivated by increasing the market opportunity

technology standards and the emphasis needed going forward to ensure that market leaders will engage actively.

In the past few years a new body of work has emerged that has attempted to implement the potential changes described in this paper. While the outcome is different, it involves a very well traveled standards topic of digital content interoperability. In the next few paragraphs the background for and nature of this work is described.

In the mid-1990's the vision of the learning management system as a delivery platform for content was heavily influenced by the emergence of intranets as the key organizational networking platform. Early practitioners in the development of learning technology standards were well aware that in terms of bringing content to users there were two options. One was to transfer a packaged learning object or course to the LMS where it resided and was "played." The other was to enable interaction between the LMS and a separate system that hosted and delivered the learning objects. The former approach required that the learning objects be highly specified and that the LMS's be capable of faithfully rendering those specifications – much like a CD player can play a CD. The later approach required a less constrictive approach in which the LMS launched the cooperating application and when that application was "finished" it would return data describing the results of the user interaction (such as a gradebook, scores on learning objectives, etc.). This later approach is much like today's widely used concept of "mashed-up" applications via web sites, such as integrating video streaming from a central service into your personal web site.

It was recognized early on that the "player" approach was going to be difficult to achieve because it required content developers to decouple their content from the environments that they had already built for delivery, which many times included complex sequencing of content based on interactions with the user. The later approach of application launch and exchange was in many ways preferable as it did not require the content-supplier to retool content to a format that LMS players could interpret and in which the user interactivity could not necessarily be faithfully preserved.

So, given the challenges to the "content player" idea, why did a solution such as SCORM, which is based on that concept, become a focal point of standards activity over the last 10 years? First, the one relatively mature model that existed was from AICC (Aviation Industry CBT Committee, where CBT stands for Computer Based Training). The AICC model was based on an LMS player idea, albeit not Internet-based, but physical loading of interactive CDs into a drive on the computer hosting the LMS. Second, the emergence of intranets and what today we would describe as a relatively immature Internet in terms of firewall constrictions,

application sharing, cloud computing, and application mash-ups meant that most organizations were interested in hosting the content somewhere on their intranet.

Today, these constraints have diminished. Distributed application mash-ups and software as a service (SaaS) are the norm today. Content providers have responded with much more sophisticated offerings that could similarly be referred to as "Content as a Service" (CaaS). CaaS models do not require porting content to play in an LMS that may not be capable of faithfully reproducing the sequencing and interactivity intended by the original designers. Table 3 compares the two approaches.

The decisions regarding "content playing," as influenced by the precursors on which it was built, created a coupling with a self-contained, self-paced learning model. However, this was not how most learning occurs, and is still a relatively small market compared to traditional forms of learning – namely classroom activities and printed materials – as shown in Figure 1. Books are no less popular today than they were ten years ago. In essence, for SCORM to become mainstream it would require, among other things, that the type of digital delivery that SCORM supports become mainstream, on par with the acceptance of the book. Of course, that has not happened. For learning technology

TABLE 3
Comparing Content Playing vs. Content as Application Mash-Up.

	Content Playing in a Learning Management System	Learning Content as Application Mash-Up
Types of standards involved	Specifications describing all aspects of content for faithful reproduction by the LMS	Specifications describing launch and exchange of data between hosted content system and LMS
Content industry ramifications	Content must be separated from sequencing logic and republished to standards	Content system must launch and exchange with the LMS to create a seamless experience (as if user is in one system, not two)
Learning platform industry ramifications	Requires major focus on content development, management, and delivery	Requires focus on access point for federating a variety of learning applications and platforms
Standards developed or in development	SCORM, AICC, IMS Content Packaging and Simple Sequencing	IMS Digital Learning Services Standards, including Common Cartridge, Learning Tools Interoperability, and Learning Information Services

standards to have mainstream influence, they must apply to the predominant learning methods.

As a result of this new focus on adapting standards to the market realities, leading suppliers have now engaged actively in a new set of standards activities. These activities are addressing the challenges of mainstream learning technology advances in 2010. This suite of standards is referred to as IMS Digital Learning Services standards. Digital Learning Services (DLS) consists of three major interoperability areas that support a new generation of learning technology. These are:

- Distributed digital learning content, assessments, in a collaborative learning context (Common Cartridge)
- Learning applications, mash-ups, software as a service, and content as a service (Learning Tools Interoperability or LTI)
- Learner information: user provisioning and outcomes (Learning Information Services)

These standards have achieved an unparalleled degree of early support from major suppliers in the marketplace. They enable what teachers, students, and those responsible for ICT (Information and Communications Technology) to achieve a more seamless and therefore effective use of a wide variety of learning technologies that are web native. A detailed narrative of the Digital Learning Service standards is available elsewhere.[15] The scenarios that are enabled are as applicable to the now established category of learning management systems as they are to social networking applications configured to support learning, new cloud-based formative assessment applications, or an innovation next generation learning framework such as Cloud Social.[16] For example, DLS standards apply just as readily to the use of an application such as FaceBook in the learning context. Figure 3 summarizes the types of digital content that are explicitly supported by the DLS standards.

The DLS standards development illustrates how interoperability activities can take into account the evolution of the learning technology standards environment, the mainstream adoption of learning technology, and the world's most pressing learning challenges as we move into the year 2010. Note that while this approach

[15] See a complete set of video narratives at http://www.imsglobal.org/digitallearningservices.html

[16] Cloud Social and IMS Learning Tools Interoperability are described in more detail elsewhere in this issue in a paper by Charles Severance, et al.

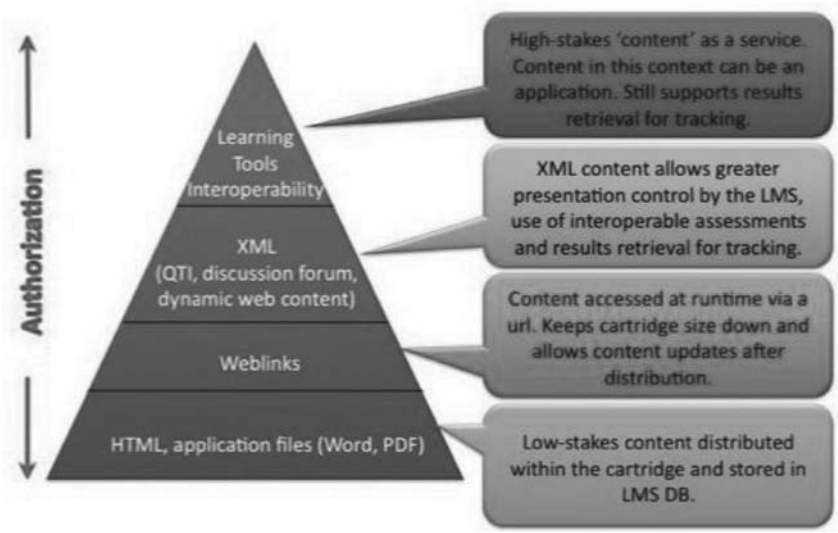

FIGURE 3
Content supported by the Digital Learning Services (DLS) standards.

is completely compatible with SCORM (SCORM objects can be facilitated as a well-defined special content type) that this is a very significant departure from the computer-based self-paced training model. Interestingly enough, the DLS body of work combines some of the same specifications used in SCORM with profiles of some of the research-driven work shown in Table 1. The net result appears to be on a track to tie learning technology standards research to the needs of the mainstream market, with the potential to impact the world's most significant learning and educational challenges.