Catalyzing Connected Learning Through Standards

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For several decades, technology-supported learning has promised to revolutionize, personalize, and democratize learning. The advent of Web-based learning in the 1990s introduced a requirement for interoperability, which generated a demand for learning-specific interoperability specifications. Few of these have achieved significant adoption. One successful approach may be called a "Plug-and-Play Learning Activity". The IEEE Learning Technology Standards Committee standardized aspects of this approach and is undertaking a significant revision of the underlying data model. The organization is collaborating with the implementation-oriented LETSI Foundation to expedite the production of a revised standard. The increased importance of mobile operating systems and "smart" devices poses challenges to the implementation and adoption of the revised standard. A possible strategy to promote adoption is to define a learning application framework of general interest that utilizes mobile technology and that incorporates the revised standard.

I. Interoperability and Technology-Supported Learning

Interoperability is the ability of a technology to interface or exchange information with another technology. Interoperability may convey clear benefits, including consumer choice among competing technologies, a context for technical innovation, and as a catalyst for mass-market adoption. The traditional means to achieve interoperability is through an engineering specification. This may be provided in several ways: as a proprietary specification from a particular technology vendor, as an "open" specification by a member consortium, or, as a formal standard from an accredited standards body such as those administered by the IEEE Standards Association.

Technology-supported learning is the use of hardware and software technology to support the delivery of an interactive learning experience. It has a long history, dating from the early 1960's. It encompasses many different kinds of learning - compulsory (K12), higher education, corporate, military - and occurs, with local adaptations, all over the world.

The consideration of interoperability for technology-supported learning is a relatively recent development. The first organization to specifically address the problem was the Aviation Industry CBT Committee (AICC), formed in 1988 and initially concerned with recommending platform configurations to support the pre-Web world of personal computers and interactive multimedia. Broader interest arose in the mid-1990's following the disruptive impact of the Web and a vision of Web-based learning. Underpinning the global connectivity introduced by the Web was an assumption of open specifications such as http and html. Extending this assumption to learning, the 1996-97 timeframe witnessed the first of many new organizations specifically focused on learning technology interoperability. Among these were the European ARIADNE Project (later Foundation), the U.S. higher-education focused IMS Project (later Global Learning Consortium), the U.S. Government's Advanced Distributed Learning Initiative (ADL), and, specializing in formal standards, the IEEE Learning Technology Standards Committee (LTSC).

Collectively these organizations have addressed a broad spectrum of learning-related problems, including descriptive resource metadata, specialized content formats, pedagogical models, administrative data, competencies and learner performance. Unfortunately, after a fifteen history there are only a handful of success stories. Reasons include limited funding and technical expertise, the diverse requirements of different market segments and geographies, overlap and conflict with more widely implemented generic technologies, and a lack of developer tools.

II. A Plug-and-Play Learning Activity

One success story, addressed in this paper, has been know by several names but to meaningfully reach a non-specialist audience will here be called a Plug-and-Play Learning Activity. Attributes of this technology include:

- self-contained;
- platform independent;
- interactive and potentially using rich media;
- delivered over a network and "connected";
- supporting an activity lifecycle having initialize, suspend, resume and terminate events;
- may be integrated with other learning activities, potentially from multiple providers;
- capable of reporting information about learner performance;
- amenable to software-based conformance testing.

The original and continuing technical approach for defining a plug-and-play learning activity was created nearly twenty years ago by the AICC organization where it was know as computer managed instruction (CMI). Special circumstances in the commercial aviation industry during the pre-Web era of personal computers necessitated the invention of this technology. At that time commercial airlines needed to deliver large multimedia courses that might have as many as one hundred lessons. For regulatory purposes, airlines needed to measure learner performance in those lessons. Courses came from vendors tightly integrated with proprietary learning management systems. Consequently, airlines acquiring courses from multiple vendors would also acquire multiple learning management systems, each having different capabilities, support requirements, and measuring different learner performance data. The CMI interoperability solution separated learning content from learning management, enabling any conformant content to be delivered by any conformant management system with both exchanging a common set of learner performance data.

AICC CMI remained a little know, vertical industry curiosity until the takeoff of Web-based learning in the late 1990's. In 1998 the AICC released a Web-based version of the CMI specification and submitted it to the IEEE LTSC for formal standardization. Three aspects were standardized as the IEEE 1484.11 suite of standards. In 1999 the U.S. Government's ADL Initiative began a process of adapting and extending AICC CMI to meet Department of Defense requirements. This was know as the Sharable Content Object Reference Model (SCORM) and eventually incorporated two of the IEEE 1484.11 standards. AICC CMI, the IEEE 1484.11 standards, and ADL SCORM are family members of a common approach to defining a plug-and-play learning activity. In the decade following the 1998 AICC CMI release this approach achieved widespread global adoption and was behind the learning experience of millions of online learners. The ADL Initiative greatly assisted this diffusion through a series of interoperability "plug-fests" events and international collaborations with partners in Europe, Asia, and South America.

Technically, a plug-and-play learning activity within this tradition comprises two main components. The first is a data model for the information exchanged between the activity and a learning management system. Most of this information is specific to learning and covers areas like learner identification, preferences, activity objectives, common question types like multiple-choice or fill-in-the-blank, scoring data, and activity completion status. IEEE 1484.11.1-2004 standardizes this data model. The second is a technical capability to support the events of an activity lifecycle and the related exchange of "connected" information between an activity and a learning management system. The Web-browser paradigm does not support this capability and a learning-specific solution needed to be invented. IEEE 1484.11.2-2003 standardizes aspects of this solution.

III. THE CHALLENGES OF CHANGE

Intuitively, most people think of a "standard" as something permanent and immutable. Engineering standards, however, are subject to periodic revision in order to correct defects or adapt to a changing technology context. In 2010 the IEEE LTSC decided to undertake a major revision of the IEEE 1484.11.1-2004 standard, the data model at the heart of a plug-and-play learning activity. Motivating the revision is a need to better accommodate the specialized requirements of diverse communities of practice who are not well served by the monolithic, one-size-fits-all design of the current data model.

The original IEEE 1484.11.1-2004 standard defined a fixed set of generally useful data elements. The data element set was intended to be used as a whole and the standard made no provision for extensions. A decade ago this strategy seemed reasonable because there were no clearly articulated requirements for different data elements. Subsequently, other relevant data models have been defined and communities of practice have become more proficient in articulating their requirements. For example, the standard defines two forms of numeric score. It has no means to represent a letter or pass/fail grade such as might be relevant to a K12 community. A major goal for the revision is to define a flexible data model definition mechanism that will enable communities of practice to choose and integrate the particular data elements they require from plug-and-play learning activities.

In an attempt to accelerate the typically slow pace of standards development, the IEEE LTSC decided to undertake the revision as a co-development activity with the LETSI Foundation. Developing a formal standard normally takes several years, and in the resource-strapped learning technology community, has occasionally taken over a decade. This pace is far to slow to remain technically relevant. Additionally, the community has seen many specifications that are not informed by implementation with unfortunate consequences. The LETSI Foundation is an organization that is taking a non-traditional approach to learning technology interoperability: agile software development; implementation before specification, early involvement by stakeholder implementers. By co-developing the revision with LETSI, the IEEE LTSC hopes to expedite the production of a standard that is effectively implemented upon release.

Work on the revision began with the assumption that it would be implemented within the same Web-browser paradigm that has been the norm since the 1998 AICC CMI specification. The increasing prominence of smart phones, tablets, and ebook readers challenges this assumption. For example, Android™ is a representative mobile operating systems that can be used by all three kinds of platform. The capabilities of Android™ differ from and exceed those of a conventional Web-browser in several important ways. There is direct support for an activity lifecycle and several options for persisting activity data. There are assumptions about how data will be structured and communicated between activities and via services. There are provisions for external notifications to activate an activity. While these cursory comments only hint at technical explanation, they signal a radical change for the idea of a plug-and-play learning activity as conceived for over a decade by the AICC, ADL Initiative, and IEEE LTSC.

Previously a plug-and-play learning activity was described as comprising a learning-specific data model and a more general capability to manage an activity lifecycle and related data communication. The IEEE LTSC standardized the data model and is now undertaking a revision with LETSI. The lifecycle/communication capability was not directly supported by the Web-browser paradigm so over a decade ago the learning technology community developed an idiosyncratic solution. With a mobile operating system the capability is not only built into the platform but comes with additional features that have been desired for years. Considering the expanding world of smart mobile platforms, a major component of a conventional model for a plug-and-play learning activity has become redundant and obsolete.

Observing technology trends, the IEEE LTSC and LETSI would like to explore the adaptation of the plug-and-play learning activity model to the capabilities of a mobile operating system. This is the context in which the IEEE 1484.11.1 revision will most likely be broadly adopted and LETSI is well positioned to coordinate the necessary research and development. However, the combination of a significantly revised standard with a significantly different software platform implies a new technical solution whose initial adoption will be zero. What can be done to catalyze adoption of this capability? Perhaps this presents a synergistic opportunity for the IEEE Global Humanitarian Technology Conference.

IV. A WIN/WIN OPPORTUNITY?

Most people do not know or care about interoperability standards. The limited resources and fragmentation of the learning technology community eliminates the financial incentive to adoption characteristic of more utilitarian standards like the IEEE 802.11 series. What if instead of trying to convince people to adopt something they don't care about – a new learning technology standard – we instead interest them in adopting something they do care about and use that to piggyback adoption of the standard. To that end, the IEEE LTSC and LETSI would like to use the IEEE Global Humanitarian Technology Conference to assess interest in an application framework for a specialized kind of learning that exercises the capabilities of mobile operating systems and related devices.

The inspiration for this framework goes back twenty years to three seemingly unrelated projects encountered by Richards in what was then the Apple Computer Advanced Technology Group. The first addressed rice ecosystem management in Indonesia. The second addressed grade school science education in a wilderness setting. The third addressed water sanitation and public health in the Philippines. In each case, the strategy was for individuals to collect relevant data at particular locations and later collectively view the aggregated data on a map. At the time the primitive state of technology precluded pursuing these applications in an ideal or general way. Small devices were new and unreliable. Global or wireless connectivity did not exist. Accurate GPS was a military prerogative and sensors filled a large backpack. Now these are all basic features of any "smart" device.

The framework represents an adaptation of the plug-and-play learning activity model to a mobile operating system context. It would support three distinct activities:

1. Overview of a problem domain
2. Individual field data collection
3. Group viewing of aggregated data

Integrated with these activities would be support for the IEEE 1484.11.1 data model revision. This would add the ability to track learning performance data to the framework, such as a satisfaction of learning objectives or the results of interactive quizzes. A field data collection activity would be transformed into a learning experience.

Usage scenarios could be any problem that integrates field data collection with learning: agricultural productivity, public health, K12 education about the environment, the response of emergency personnel or citizens to a natural disaster.

The IEEE LTSC and LETSI intend to complete the IEEE 1484.11.1 revision within a calendar year. Assuming the IEEE Global Humanitarian Technology Conference will be an annual event, the IEEE LTSC and LETSI would like to assess the feasibility of making the described framework real by the next conference. We are particularly interested in identifying parties who could assist in making the technology real, including providers of mobile operating systems and platforms. Equally important are parties who can define and perhaps explore relevant usage scenarios