Plug and play learning application integration using IMS Learning Tools Interoperability

Simon Booth
University of Stirling

Susi Peacock
Queen Margaret University

Stephen P. Vickers
The University of Edinburgh

A key barrier to providing learners with engaging learning experiences is the deployment of new, innovative technology. This requires collaborative effort between teachers, system administrators and application developers. The shared goal is to make it as easy as possible for learning applications to be used by learners; the shared challenge is achieving this in a cost effective manner. The IMS Learning Tools Interoperability (LTI) specification provides new opportunities for addressing this issue and provides significant benefits to all three parties. Using LTI can provide developers and system administrators with a standard mechanism for integrating learning applications with existing systems (such as a virtual learning environment) and allow teachers greater freedom to select applications which best meet their pedagogic needs.
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Introduction

The learning and teaching ecosystem is constantly under review with recurring debates within Higher Education about the role and function of the virtual learning environment (VLE) in supporting blended and online learning (Littlejohn & Pegler, 2007; Garrison 2011). For example, this was one of the topics at the 2009 JISC CETIS conference (MacNeill, 2009) at which different models for distributed learning environments were discussed. Subsequently these were summarised in a briefing paper (MacNeill & Kraan, 2010) under the headings of:
1. system in the cloud, many outlets;
2. plug-in to VLEs;
3. many widgets from the web into one widget container;
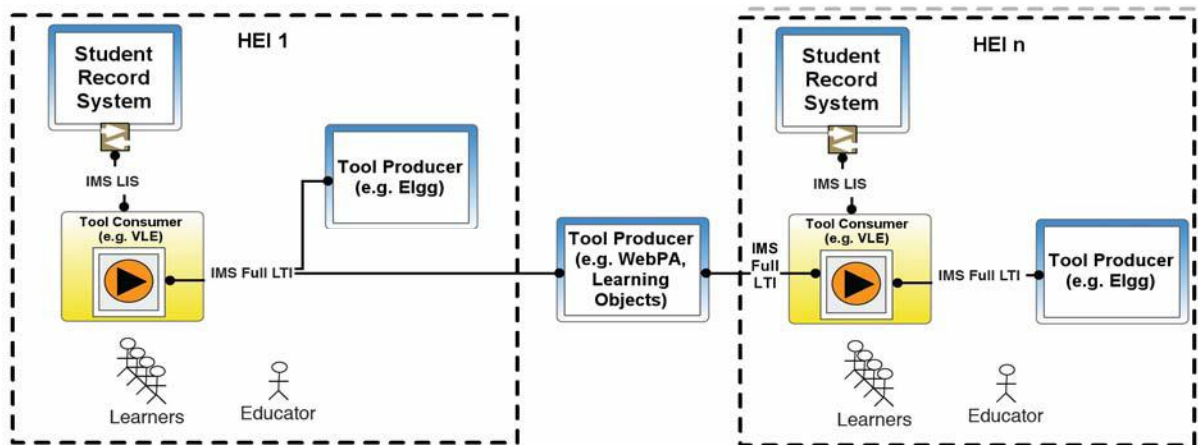4. many providers and many clients;
5. both a provider and a client.

Figure 1: Enhanced "plug-in to VLEs" learning environment model

The common theme was a recognition that a VLE is not the sole source of applications used for teaching and learning; a complete view of a learning environment involves some form of integration of disparate learning applications. This paper outlines a variation on model 2 which retains a central hub (such as a VLE) from which connections can be made to other applications, both ones hosted internally by an institution (such as Elgg in Figure 1) and externally hosted, shared services (such as WebPA in Figure 1).

Teachers value a secure, central single point of entry into an on-line learning environment which enables students to move seamlessly between learning activities regardless of where the applications may be physically located (within or outwith the institution). Such deep integration allows the tutor to focus on the pedagogical design and organisation of a learning environment leading to the development of both social and cognitive presence (Garrison 2011). Unfortunately when trying to blend a range of applications to develop a challenging learning environment, tutors too often find themselves faced with a range of "labels and artificial standards" which limit their experimentation with learning technology (Garrison 2011, p76). The IMS Learning Tools Interoperability (LTI) specification has the potential to remove these limitations by:

- providing a quick and easy mechanism by which additional learning applications can be made available to learners and tutors;
- supporting the movement of data between systems;
- extending collaboration to include learners outside the institution.

This should enable the tutor to focus on supporting learners in meeting the educational outcomes of a programme of study rather than worrying about how students log into online learning environments and move between disparate applications.

IMS Learning Tools Interoperability

The IMS Learning Tools Interoperability (LTI) specification (IMS Global Learning Consortium, 2011b) is designed to provide a standard mechanism for connecting a learning application (referred to as a tool provider) to a central hub such as a VLE (referred to as a tool consumer). The implementation of LTI in an institutional learning environment is illustrated in Figure 2.
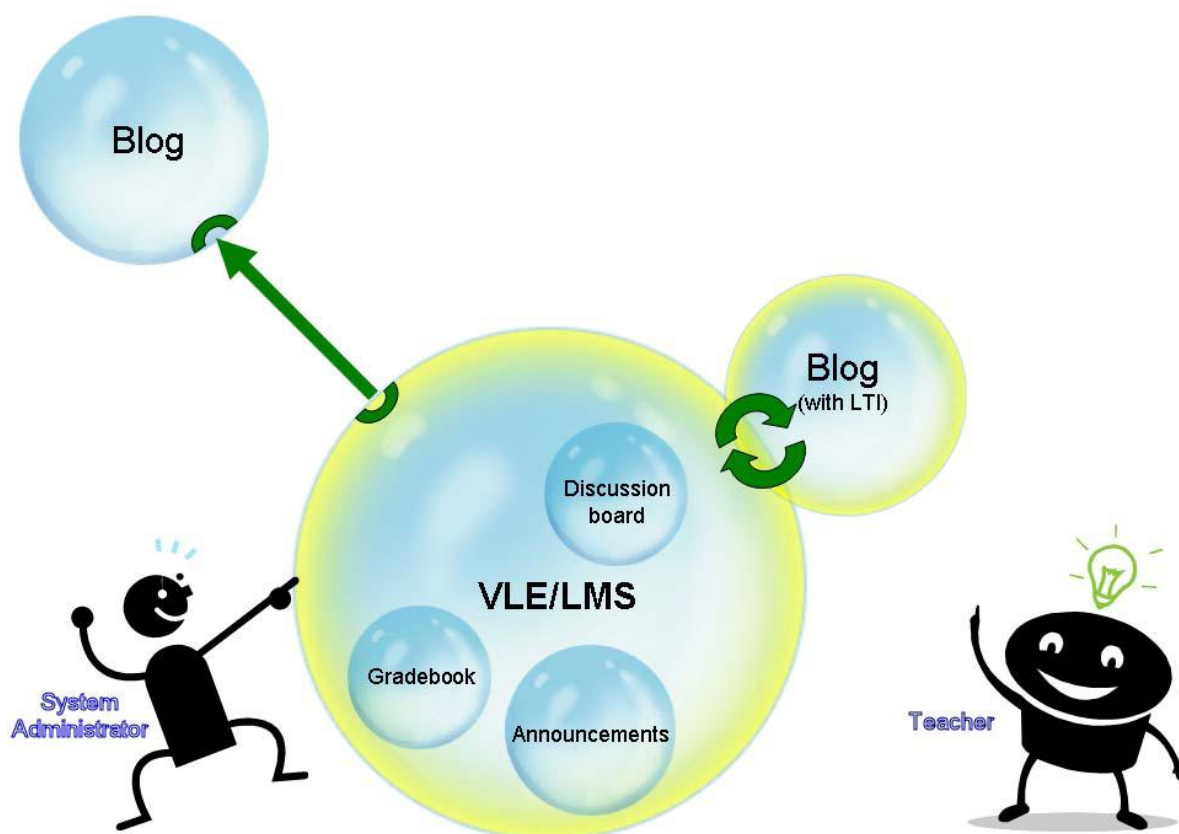
Figure 2: A visual representation of the implementation of LTI

A VLE comprises numerous core applications such as a gradebook, an announcements system and a discussion board. However, by its nature, the VLE will never provide *all* the learning applications demanded by teachers. Traditionally an external blog service, for example, might have been integrated with the VLE by writing custom code at both ends to enable users to launch the blog from within the VLE. Whilst such an approach has commonly been used, it relies on appropriate access to each system and the required developer expertise. The Basic LTI specification released in 2010 implements this form of "launch" (one-way) connection in a standard way such that any tool provider supporting Basic LTI can be connected to any tool consumer which supports Basic LTI. Basic LTI is already supported by all the major VLEs as well as many other learning systems (such as Campus Pack or PebblePad). Severance (2010) and Severance, Hanss & Hardin (2010) provide interesting use case examples of applications of LTI.

The Full LTI specification (not released at the time of writing) extends the design to provide a tighter, two-way integration between tool consumers and tool providers. This allows an external tool to exchange data with the tool consumer (such as enrolments and grades). It also provides a mechanism by which the tool provider is notified of relevant actions undertaken by users within the tool consumer (such as copying a course). In this way an external tool can closely resemble the behaviour of a tool embedded within the VLE and minimise the impact on users.

Impact of Learning Tools Interoperability

Developing a Community of Inquiry

Over the last decade, the community of inquiry conceptual framework has emerged which supports the planning and design of online learning in higher education (Garrison 2011) Drawing heavily on emergent research into online and blended learning and strongly influenced by the work of Dewey, this framework proposes that an online community of inquiry will support learners to develop appropriate skills and knowledge to become creative and critical thinkers. A community of inquiry is:

a group of individuals who collaboratively engage in purposeful critical discourse and reflection to construct personal meaning and confirm mutual understanding. (Garrison 2011, p. 15)

Three interlocking elements are essential for the development of an online community of enquiry: social, cognitive and teaching presence. The IMS LTI specification supports the development of each of these linked elements by providing a toolbox from which tutors can select appropriate applications to create a seamless learning environment.. For example, a tutor may select:

- *on-line discussions* within a VLE to be used as a trigger activity focussing students on a specific problem but also informing tutors about their learners' current conceptual understandings or misunderstanding of the subject area; such an activity allows learners to develop a connection with the course and fellow students, thereby developing personal and affective relationships;
- *blogs* (outwith the VLE) provide an ideal reflective tool for critical thinking and personal meaning making;
- a *wiki* (within the VLE): an ideal area for learners to explore a specific topic, gather a range of materials and start to develop group meaning;
- *online synchronous tools* within a VLE allowing groups to present their developing ideas in the wiki which can challenged and probed by the Community;
- an *ePortfolio* outwith the VLE provides an individual summative assessment tool.

The adoption of LTI simplifies the process of selecting and implementing new learning applications for tutors. Instead of worrying about if such applications can be used in combination, tutors can focus on designing and maintaining an engaging and stimulating learning environment which facilitates critical discourse and leads to personal meaning making.

Benefits for technologists
The IMS LTI specification also provides benefits to all those involved in delivering online learning experiences to learners including:

- system administrators;
- learning technologists;
- application developers.

Impact on system administrators
Some VLE implementations of Basic LTI (such as Blackboard Learn 9.1) enable teachers to add their own connections to LTI-compliant applications reducing the workload for system administrators although diligence checks on the service provider and data security tests are still required. However, since LTI can be used for both internally-hosted and externally-hosted applications, it can provide institutions with a convenient mechanism for implementing their own developments as well as those from third parties. Furthermore, "Full" LTI provides support for administrative operations such as backing up, copying and restoring courses where the data relating to these courses may be spread across multiple systems.

Impact on learning technologists
Supporting a diverse range of learning applications which do not interconnect gives rise to pedagogical and technical challenges for learning technologists. Disparate systems require significant amounts of support to ensure that learners and tutors know how and where to access such applications in a timely fashion. This distracts from the pedagogical support that learning technologists can provide to academic colleagues and furthermore inhibits tutor innovation in developing an holistic learning environment.

Impact on application developers
The main benefit for developers is that adding support for LTI will enable their application to be integrated with a wide range of VLEs and other systems. This removes the need to create and maintain individual integrations for each VLE, such as a Moodle module, a WebCT PowerLink and a Blackboard Building Block. This does not prohibit a tighter integration from being written for specific VLEs where customer demand warrants the investment.

Conclusion
The adoption of LTI truly delivers benefits to all parties involved in delivering engaging on-line learning experiences to learners. Teachers should find it easier to locate applications which they can use in a seamless manner; the effort required by system administrators to check and deploy a connection to an external learning

application is significantly reduced, thereby increasing their ability to support more of the applications demanded by users; and developers can make their applications more widely available through a single integration. The use of LTI makes it more feasible for staff to innovate in their teaching and learning practices and for successful experiments to be deployed more widely across the institution.

The number of applications and systems which have already demonstrated conformance to the Basic LTI specification (IMS Global Learning Consortium, 2011a) suggests that there is widespread appreciation of the benefits to be derived. Continuing the trend of increased adoption merely serves to increase the benefits being delivered to the education community.

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