LO -> LA: From a Learning Object centric view towards a Learning Activity perspective

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LO→LA

From a Learning Object centric view towards a Learning Activity perspective

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Abstract

This article argues why we must focus on the *learning* in e-learning. We hold a plea to rethink the current learning *object* centric paradigm in e-learning technology towards a more learning *activity* centric perspective on e-learning. After examining current needs in educational practice and the state-of-art in learning technology, we discuss the extent to which available specifications and LMS cater for these needs. We conclude that learning technology should be enhanced with a specification able to capture a larger and more innovative variety of new pedagogical approaches to learning. As a solution to this problem, we propose that the IMS Learning Design specification offers a more generic pedagogical framework to also enable more activity-based and collaborative learning designs for a large variety of approaches and domains.

Keywords: learning design, instructional principles, learning technology, learning activities, learning objects

Introduction

Both higher and distance education are currently exploring new technological possibilities for lifelong learning (e.g., Fernandez-Manjon & Sancho, 2002; Retalis & Avgeriou, 2002). The learning objects movement has grown over the past years, and is becoming increasingly mainstream. Several specifications and a standard for learning objects exist, and there is much interest in meta-dating and content packaging. The process of moving from specifications to standards continues to gain momentum.

The *push*, focus and aspiration of much e-learning nowadays is on effectively bringing people to standardized content in a 24/7 form factor. However, there is a growing feeling of uneasiness, that we risk e-learning to become merely page-turning according to a people-to-content model. Paul Stacey (2003a) describes this phantom as “static, fossilized, dead [content], low learner motivation and engagement, impersonal and isolating environments”. Teachers cannot be completely eliminated from the actual delivery of courses in all cases, self-paced study cannot be the sole pedagogical model (not even at an open university), and learners do not just want pre-packaged and static content.

Besides linking people to content, e-learning’s market *pull* is for bringing people to people and address the human side of learning (e.g., Brown, Collins & Duguid, 1989; Dillenbourg & Schneider, 1995; Wood & Wood, 1996). The availability and form of learning objects should not direct to mere consumption of content by individual learners, but rather support the need for more active learning by both individuals and groups that may (or may not) make use of learning objects during the teaching-learning process.

So, how do we design learning moments and how should active content look like? Active content evolves and can be updated. Active learning environments are more like learning communities than learning repositories; we need places where questions can be asked and answered, where information can both be collected and offered, where real people provide guidance and inspiration. Active learning uses peer-to-peer learning and interaction. Content created by peers often proves to be just as good, if not better, than teacher or expert created content. In active learning the role of teachers is not just that of the content expert, but also of a mentor, tutor, coach, demonstrator, administrator, evaluator, or peer. We believe these issues to be very timely now that the WWW is being promoted with increasing urgency, but without clear design concepts or tools (Fairweather & Gibbons, 2000).

This article is a quest for more innovative and timely design methods and concepts, and for adequate supporting tools in learning technology. Join us on our journey by first exploring the current needs in educational practice, which seem to be echoed by more advanced insights about the way people learn. We then proceed by investigating the extent to which current learning technology and available LMS cater for these needs. This will lead us to conclude that the learning object centric view hinders real innovations in e-learning, and (temporarily) puts us one step backwards. To really benefit from technological possibilities, we propose a more learning activity oriented perspective, framework and specification. A description and evaluation of the IMS Learning Design specification demonstrate that this specification can indeed enhance future e-learning.

Educational needs and problems

To capture current educational needs and practices in e-learning, the educational professionals are in need of more advanced specifications and LMS. Educational practice is exploring ways to shape multi-actor collaboration, peer interactions, personalization and adaptive, more active and alive content sharing, but does not yet find this practice supported in commercially available LMS.

Based on a study of current pedagogical models, Merrill (2003) summarized them as follows: “… the most effective learning products or environments are those that are problemcentred and involve the student in four distinct phases of learning: (1) activation of prior experience, (2) demonstration of skill, (3) application of skill, and (4) integration of these skills into real-world activities". The main focus in education should be on longer training programs aimed at the attainment of competences or complex skills through authentic tasks, and no longer on the learning of isolated facts and skills. In these authentic tasks, new knowledge should first be demonstrated to and then applied by the learner, integrated into the learner's world (e.g., Van Merriënboer & Sweller, in press).

Where Merrill's analysis is dealing with single learners, other developments in education involve multiple learners and the shift towards social-constructivist approaches to learning. Effective education should not only be active learner-involved but also be participative community-involved (Bransford, Brown and Cocking, 2000). An important notion for these social-constructivist approaches to learning is that knowledge is not absolute, but relative to the interpretation and beliefs of communities of practice. Therefore, the social context should be represented in a learning situation (Lave & Wenger, 1991).

State of the art in Learning Technology

The currently most used Learning Management Systems (LMS) (e.g., Blackboard, WebCT, Lotus Learning Space, LearnExact) provide authoring and playing facilities that are only suitable for one specific educational system and pedagogical approach at hand. The most advanced of the LMS are based on the IEEE Learning Technology Systems Architecture (LTSA), and use standardized content structuring based on the ADL Sharable Content Object Reference Model (SCORM) that makes it possible to exchange and reuse learning content (i.e. learning objects) only (for an industry report see e.g., Masie center, 2003). Authoring tools, that support the LMS, do not enable designing activities based on state-of-the-art pedagogical approaches such as constructivist and collaborative learning.

In order to enable the actual sharing, reuse, and repurposing of learning activities, current limitations of LMS first need to be overcome. The Learning Technology field is still struggling with the open question of how web-based educational systems can be designed that are better suitable to *manage and exchange learning activities from various pedagogical approaches and LMS*. In order to achieve a higher-level architecture based on a *more general* pedagogical approach, the field is in need of a specification that caters for various learning designs. We will need a Model Centered Analysis Process, based on set of instructional principles, to think of various generic problem structures (Gibbons & Nelson, in Wiley, 2002). Just like Mendeleyev's 1870 creation of the periodic table laid out the basic building blocks of all physical matter, we need some basic structural makeup for all learning matter (Hodgins, in Wiley, 2002). It must provide some of the basic 'rules' that govern which learning objects can be combined and how, natural pairings, nesting structures, et cetera.

The need for e-learning systems that support a large pedagogical variety of approaches in education is now considered to be a key issue in web-based learning. More innovative Research and Development efforts in the field of Educational Technology have mainly been aimed at the development of non-SCORM conformant educational systems (see e.g., Brussilovsky, Eklund & Schwarz, 1998; Murray, 2002; Vassileva & Deters, 1998) that were tailored towards *specific* approaches (e.g., providing active learning, intentional learning, contextual learning, constructive learning, reflective learning). Besides only serving a specific pedagogical approach for a specific domain (e.g. Active Math), these self-contained systems are not flexible across LMS.

Next to instructional principles, some technical limitations need to be addressed before learning objects can be widely used in our educational communities from K12 through lifelong learning. Halm (2003), for instance, mentions the necessity of the process of metadata creation to become less onerous, the lack of qualitative information (fort instance about the context in which they are used) about learning objects, the urgent need for methods to identify and create specific metadata structures, and the need to articulate the relationships between learning objects and report these to the repository. The last years, a number of new specifications have been aimed at broadening the access to learning objects and support a wider range of pedagogies in e-learning. These specifications include the IMS Digital Repository Interoperability (DRI) and IMS Accessibility for Learner Information Package (ACCLIP). DRI provides the capability to bridge various repositories with a single query. ACCLIP provides opportunities to customize and adapt the learning experience based on user preference. We will now first describe the limitations of the current learning object centric view and of the SCORM model implemented in most LMS.

Learning objects paradigm

The fundamental idea behind learning objects is that designers can build small (relative to the size of an entire course) instructional components that can be reused in different learning context. The LTSC described these components as “any entity, digital or non-digital, which can be used, reused or referenced during technology supported learning” (LOM, 2000), so basically includes anything referenced to. It is misleading to think of learning objects simply as being independent entities, like jigsaw pieces or lego blocks or any other single definable object, because they are multi-faceted. Merrill, Li and Jones (1991) introduce the terms ‘knowledge objects’ and –later- ‘instructional objects’ to the instructional design vocabulary, where others also speak of ‘educational objects’ or ‘intelligent objects’. But adding names with more instructional meaning to the vocabulary will not suffice without clear guidelines for using and combining these entities. Wiley (2002) recognizes the need for instructional design, strategies and criteria, to play a large role in the application of learning objects if they are to succeed in facilitating learning. He argues that the two major issues for employers of learning objects, granularity (how big should a learning object be?) and combination (how can learning objects be meaningfully combined?), may turn out to be familiar considerations better known as scope and sequence. We therefore need ID theories that provide explicit scope and sequencing support, like Van Merriënboer's (1997) 4C/ID model.

However, there still is astonishingly little conversation around the instructional design implications of learning objects. Interoperability has been the dominating element in specifying learning objects, mainly because vested interests in commercial applications are huge. Learning objects are likely to become the instructional technology and the world will be flooded with object-based tools. However, technical standards and venture capital are important but not enough to promote learning. Technology-enabled learning should be guided by instructional principles. Without attention to the process of instruction, interoperability and reusability of learning objects will not materialise. Educational designers must first establish how students could be studying most effectively. Software vendors and standards bodies offer products that are presented as being 'instructional theory neutral' (e.g. in the information model of the IMS Content Packaging specification, or in the SCORM reference model), while in fact they implicitly reflect more traditional teacher-centred knowledge dissemination approaches. When software vendors argue their LMS to be 'pedagogically neutral', in fact a more accurate qualification would be 'pedagogically agnostic'. In a world without any instructional theory where just anything goes, the emergence of meaningful learning is highly unlikely. Or, as Wiley (2002, p. 20) explains by analogy: "A person without understanding of instructional design has no more hope of successfully combining learning objects into instruction than a person without understanding of chemistry has of successfully forming a crystal". We feel that most of the commercially available LMS reflect old ways of learning embedded in objectivist views on learning ('putting old wine in new vessels'). At its best we have libraries and curricula of off-the-shelf, 'prêt a porter' or custom designed, e-learning content taken and accessed autonomously through independent self-service. In the worst cases their possibilities are limited to ‘clip-art slide shows’ or course notes on the web, not allowing for any active role of the learner.

Limitations to SCORM

The third layer of IEEE/LTSA’s five-layered SCORM reference architecture specifies the main components and interfaces of the LMS. In this architecture, ‘content’ is simply represented as stored resources (learning objects), and the interaction of actors (learners) is represented as a unidirectional flow from the delivery system to the actor. Consequently, interactions from the actor to the content are not supported. This ‘single learner’ model assumes that a learner interacts only with learning objects in content-based activities. Although the latest (2004) version of SCORM integrates an extra specification, IMS Simple Sequencing, to define learning paths and conditions, this unfortunately does not warrant more innovative education, simply because it still focuses on content and not on activities.

The architecture defines interactions between two actors, the learner and the teacher, and only interactions between them are supported. Consequently, interactions with learners are not supported in the system components layer. This means that, when modelling learning activities, SCORM 2004 neither caters for interactions between participating actors and with the environment, nor for multiple participating roles (e.g., students working together with various responsibilities in project-based work) and their interactions.

SCORM does not allow development of specific application profiles, and still lacks the integration with specifications that are needed to support education. There is no way to change this, since SCORM is not an open standard (you cannot become a member of the ADL). We have to face that SCORM 2004 does not foster more recent views on education; adoption of it might even put the teacher backwards in time, because she or he will not be inclined or motivated to imagine more than just what the LMS offers.

Requirements for a learning design specification

The educational needs in educational practice and limitations in learning technology need to be addressed with new design methods, authoring tools and runtime systems. Since the focus of this article is not on concrete tools or implementations, we wil only list the requirements for a new interoperability specification that can capture the design of the learning and teaching process. Besides the general, more technical requirements for interoperability (reusability, formalization, reproducibility), such a specification must be able to (Koper & Olivier, 2004):

- fully describe the teaching-learning process in a unit-of-learning (*completeness*);
- express pedagogical meaning and functionality of all elements in the design (*pedagogical expressiveness*);
- describe personalization aspects, so that content and activities can be adjusted according to learners' needs and preferences (*personalization*); and
- enable learning designs to use and integrate other available standards and specifications where possible (*compatibility*).

IMS Learning Design

Reusing learning activities from different LMS assumes that all the required functionalities in a learning process (and this will not just be a 'single learner' interacting with content) can be modelled in a meaningful and understandable way according to a specification, and that LMS based on this specification include all components to support a variety of learning scenarios. To this end, standardization efforts have led to the development of various Educational Modelling Languages (EML, see e.g. Rawlings et al., 2002), and finally the IMS learning Design (LD) specification, which was based on the EML developed by the OUNL. LD provides a standard notation for describing a wide variety of pedagogical approaches based on a pedagogical meta model that indeed has proved to be ‘pedagogy-neutral’. IMS LD provides a counter to the trend towards designing for lone rangers reading from screens. It guides teachers and designers to start with activities and objectives in stead of with content, because learning can also happen without any content, is highly personal and, foremost, should be active.

IMS Learning Design goals

One of the primary goals of the IMS Learning Design specification (LD, 2003) is to *support a wide variety of pedagogical approaches to learning*. LD serves as a kind of common denominator that could be distilled after researching the communalities in various learning theories and scenarios. In the heart is a model that underlies many different behaviorist, cognitive, and social-constructivist approaches to learning and instruction. The model revolves around modelling ‘units of learning’, elemental units providing learning events to satisfy one or more learning objectives. There is no predetermined notion of how large a unit of learning should be. This is a powerful concept, since every unit of learning can consist of smaller units of learning, enabling complex structures. Such a unit of learning is defined as a ‘systematic aggregation of learning activities that are necessary to reach certain learning objectives, including the environments and resources that are needed for executing those activities’. In a unit of learning, people act in different roles in the learning / teaching process, and work towards certain outcomes by performing learning / support activities within an environment, consisting of learning objects and services. This is elaborated in various ways, but now we mention the most salient (with a more elaborate description of some of the concepts to follow a little later):

- learner and staff are organized in roles that can be nested;
- activities are organized in structures that can be nested;

- performing an activity creates an outcome, which can be stored in the environment and can trigger a notification;
- the flow of activities can be influenced by conditions (e.g. to adapt or personalize).

A second goal of the LD effort was to *support portability and content reuse*. In order to achieve this, LD separates the educational method, the learning scenario or didactical structure from the concrete instantiation (e.g., the concrete learning resources and services), so that learning scenarios can be reused for various content objects (e.g., the skeleton for a Problem-Based Learning course can be used to structure approaches to medical problems, political problems, physical problems, computer science problems, et cetera). Vica versa, the same content objects can be reused for various learning scenarios or models (e.g, information about an area that was appointed as a soil protection area might support both biology and law students in both Case-based instruction or Problem-oriented approach). In LD we can design various and multiple roles, allowing both teacher-led and student-led scenarios. Because the LD specification builds on the IMS Content Packaging (CP) specification, it becomes possible to combine or integrate single learner with more complex activity-based scenarios.

A third goal of the LD work was to *enable support for collaboration, personalization and adaptability without a great deal of complexity*. We have chosen to achieve this by developing three progressive XML schemas instead of one, with each additional schema to support greater degrees of complexity in the design of the learning experience. Level A provides the basic element needed for a learning design. Level B adds support for personalization and adaptability (by using conditions), and level C adds assistance for collaboration including the ability to communicate outcomes of a specific learning activity (by using notifications). The implementation of LD in a architecture, allowing both the authoring, management and delivery of LD will remain out of scope in this article. We will now continue describing the core concepts of the LD specification, provide an exemplary scenario of a course modelled in LD, and give a short overview of current work and tools around LD.

Conceptual model of LD

Figure 1 contains an overview of the conceptual structure of the LD specification.

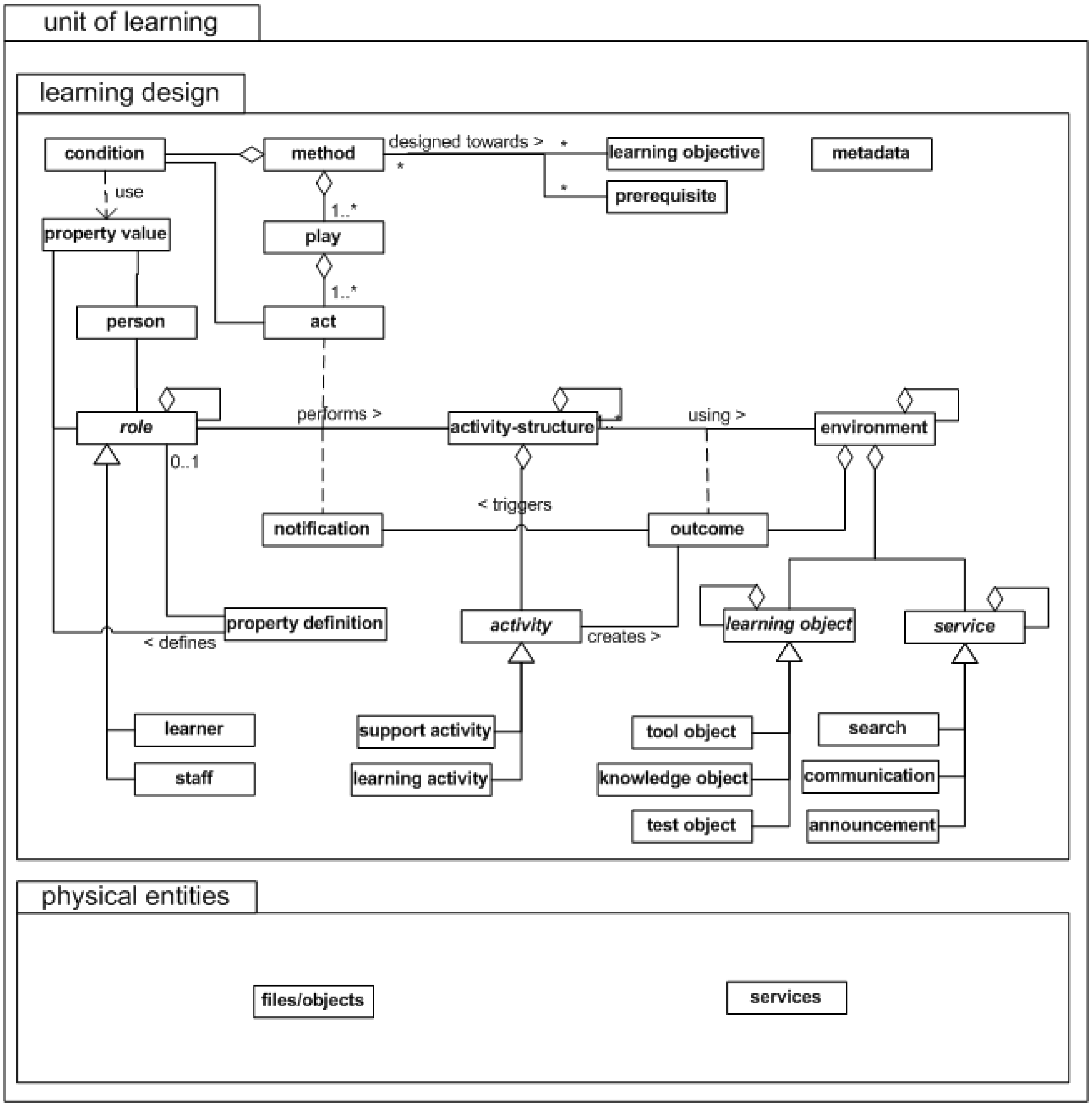

Figure 1. LD information model

Like we described before, you can see the core concept reflected in the UML diagram. A person gets a *role* in the teaching-learning process, typically a learner or staff role. In this role she works towards certain outcomes by performing learning and / or support *activities* within an environment. The *environment* consists of the appropriate learning objects and services (or none) to be used during the performance of the activities. Which role gets which activities is determined by the LD *method*, or by a *notification* (Both drawn as an association relationship with role – activity). More specifically:

- the method coordinates roles, activities and environments and specifies the teaching-learning *process*. All other concepts are referenced from the method. Methods consist of concurrent *plays* (like in a theatre), that consist of one or more sequential *acts*, that consist of *role-parts,* that are associated with activities or activity-structures.
- *Activities* can be assembled in *activity structures*. These structures can model a sequence or a selection of activities. In a *sequence,* a role has to complete the different activities in the structure in the order provided. In a *selection*, a role may select a given number of activities from the set provided in the activity structure.
- An *environment* contains learning objects, learning services and sub environments. Learning objects may be anything used in learning, like web pages, articles, books, databases, software and DVDs. Learning services specify the set-up of any service that is needed, like communication, search, monitoring or collaboration services.
- A method may contain *conditions* (if-then rules) that further refine the assignment of activities and environments for personalization of learning for specific users or learning styles (e.g., based on the outcome of your prior knowledge test, you may choose to follow a ‘listening to jazz’ course according to either a historical or thematic learning route).
- A method may also contain *notifications* as a mechanism to make new activities available for a role, based on certain outcome triggers (e.g., when a user has profile ‘law student’, the environment containing the case material can automatically be adapted to provide the more legal information in a ‘environmental law’ course). The

mechanism can also be use to adapt task settings, where a consequent activity may depend on the outcome of previous activities or other learners (e.g., the change of a property value, the completion of an activity).

- *Properties* are containers that can store information about persons' roles and the unit of learning itself (e.g., user profiles, progression data, testresults, learning object added during the process). Global properties are used to model portfolio information and can be accessed from any other unit of learning. Local properties are only accessible within the context of a specific run of a unit of learning and are used for temporary storage of data.

This conceptual model is implemented as follows. A unit of learning, modelled in LD, is represented as an extended IMS Content Package, by adding the LD element within the CP Organizations element. LD contains 'place-holders' for the integration of all other relevant specifications (mainly IMS Meta Data, IMS Question and Test Interoperability, IMS Simple Sequencing) needed to fully model units of learning. Details of the Information model and XML binding, as well as all elements that represent the conceptual model are given in de full specification documentation (LD, 2003).

Exemplary learning scenario modelled in LD

The core requirements of a learning design specification have been tested with LD on a variety of scenarios or 'use cases' that were submitted by various IMS members (both software vendors, research labs and universities) as part of their educational practice. About ten were selected and modelled as units of learning, using different pedagogical approaches, and presented in the Best practice and Implementation Guide (BPIG, in LD, 2003). As an example, a learning scenario for a problem-based course, which could be modelled in LD, might run about thus (note that static content is lacking):

- A problem is set by the coordinator and made available to the group on the website;

- Students read the problem, decide (in a synchronous conferencing system) on roles (chair, spokesperson, reporter) in the group, and arrive at a group solution, assisted by a group facilitator;
- The chair states the solution and makes it available on the website, while the group continues to explore possible solutions, that are also listed on the website;
- Other groups might be allowed to use other groups' reports on the website; and
- An evaluator and the facilitator discuss the performance of the group; the evaluation is also place on the website.

Current developments and work around LD

The IMS LD specification has been released February 10, 2003. Although EML, its predecessor, was heavily validated, tested and implemented before that date, this release is still relatively recent. Also because it is a relatively large and comprehensive specification, large-scale implementations can be expected to follow only after supporting authoring and runtime tools have become available. A number of issues still need to be further explored or solved, like (Koper & Olivier, 2004):

- further evaluation of pedagogical expressiveness;
- better integration of QTI into the LD (mapping the QTI results on LD properties);
- provision of additional schemas for new learning services, or –preferably- a generic service definition;
- agreement on learner characteristics, to be defined as extensions to IMS LIP;
- authoring tools and runtime systems to establish interoperability, and aimed towards different pedagogical needs;
- repositories that understand the structure of LD to analyse designs, look for components to be reused; and
- ongoing awareness raising throughout the world.

In Europe, Australia and Canada, though less it would seem in the US, we can notice a fast growing amount of awareness and interest for the enhancements that LD offers, and many parties are eagerly awaiting or working on the delivery of the first LD compliant tools. Open source reference implementations are developed, commercial and open source developments are underway, there are LD focused support groups and CoP, conformance testing is in play, and there appears to be lots of interest in LD worldwide.

So, a lot is currently going on here, but let us mention the most salient and concrete developments. A architecture for a distributed LD authoring and runtime environment has been proposed by the so called Valkenburg group, an international group of parties working on LD tools and architectures. The RELOAD (a JISC funded project in the UK) authoring environment (dealing with LD levels A, B) is a realisation of this architecture (available through http://www.reload.ac.uk). In order to support designers in the systematic modelling of units of learning, a basic design procedure for e-learning courses has been proposed by Sloep, Hummel and Manderveld (2005) in a recently published book on Learning Design, written by members of the Valkenburg group. The OUNL has recently released CopperCore (2004), an open source reference implementation for a LD runtime engine (able to handle LD levels A, B, C), which also enables to actually manage and play a unit of learning (available through http://www.coppercore.org). In Canada, a research group at the University of Quebec around Gilbert Paquette has developed MOT+, a graphical editor for learning activities that is being adapted for LD, together with a runtime engine called Explor@-2 that is the basis for a LD runtime player (available through http://www.licef.teluq.uquebec.ca/francais/real/demot.htm). LAMS (Learning Activity Management System), that is currently getting a lot of attention, was developed under James Dalziel at Macquarie University in Australia. LAMS (information at http://www.lamsinternational.com) is described as ‘LD inspired’; it implements many of the LD concepts, but is not an implementation of the specification. We finally mention the

(European Union funded) UNFOLD project that offers Communities of Practice for all designers, developers, and teachers interested in exchanging information about the LD specification (available through http://www.unfold-project.net). For instance, the UNFOLD community is currently developing a large variety of runnable units of learning, which will help to further validate LD's expressiveness.

Conclusion

In the near future e-learning content will broaden from just static content to active and alive content, emphasizing collaboration and interaction. Virtual meeting rooms, remote application sharing, Voice-Over-IP, and distributed participation in live events will create new forms of content. Over the next couple of years we can expect e-learning to expand and include integration of applications for blogs, instant messaging, interactive polling and feedback, voice boards, threaded discussions and conferencing, knowledge exchange and webcasting of scheduled 'live' guests in an effective blend of technologies that will enable active and alive learning environments (e.g., Stacey, 2003b). Furthermore, e-learning content developers will further diversify pedagogical approaches from lectures, self-guided courses, and presentations to webquests, game-based learning, simulations, team-based learning and other more alive, collaborative and active approaches.

Throughout the article we had to conclude that the current learning objects centric view in e-learning does not cater, but instead hinders, these new approaches to learning. Most commercially available LMS are based on the SCORM reference model that suffers a number of critical limitations. More innovative, non-SCORM based, LMS do facilitate new approaches, but stay limited to certain approaches and domains and do not allow for flexible portability across LMS.

As a solution to these problems, we presented our vision on educational practice as reusable learning designs, able to be downloaded and customised by staff and designers, coupled to reusable learning objects and interpreted by IMS LD aware environments, giving learners the stimulating, active, challenging and exciting experiences they deserve. We have tried to convince the readers that LD provides the necessary pedagogical framework that structures the relations between various learning objects, and redirects attention to the instructional value and use of learning objects. The framework is both meaningful enough to combine learning objects in real learning activities and enough to support both old (behaviorist and objectivist) and new (social and constructivist) ways of learning, which assures the wide and sustained reuse of specifications. LD appears to significantly enhance what can be done in e-learning by adding a number of ‘unique selling points’: coordination of multiple users, integration of learning objects and services, supporting generic properties and conditions that enable personalization, and the ability to support various pedagogical approaches. But most of all, by adding a learning activity layer over learning objects and services to enable more active and alive e-learning, and not merely content-centric learning. Instead of content, let active learning be king.

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