LEARNING DESIGN VERSUS LEARNING EXPERIENCE DESIGN: IS THE EXPERIENCE API MAKING THE DIFFERENCE?

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Abstract

Learning Design (LD) emerged from the development of educational modeling languages used for the description of learning scenarios. As a formal specification (IMS-LD) of their interoperable representation it can operationalize a wide variety of instructional models in terms of roles and activities and other standardized concepts in a machine readable way. Unfortunately, with the notable exceptions of the Open University of the Netherlands (OUNL), IMS GLOBAL Learning Consortium (IMS), and some devoted centers of instructional design, its use could not become widespread community practice, and IMS-LD apparently faces the destiny of top down educational standards as HTML5 based mobile learning trends call into question its usability. The usability problems that led to simplified but expressive tools for designing, managing, and delivering online learning activities, such as J. Dalziel's Learning Activity Management System (LAMS) converge towards issues of Learning Experience Design (LXD) that transplanted principles of usability engineering from the User Experience Designers' (UXD) community into the field of technology supported e-didactics. Meanwhile, the new Training and Learning Architecture (TLA) of Advanced Distributed Learning is transforming the landscape of activity management with the introduction of the new Experience API (xAPI/TinCan) specification. Both IMS LD and xAPI exceed the Simple Sequencing methodology of SCORM and focus on the organization of learning activities, but their approaches are related to different knowledge management conceptions. LD is more education oriented, while xAPI is closer to the learner centered knowledge management conception of LXD. Reconsidering the original goals of LD forces the conclusion that it is worthwhile to maintain its modeling advantages, separating issues of interoperability, machine interpretability of course management, and transparency of modeling learning scenarios. "Don't make me think (unnecessarily)" is a rule of the "second media age" that does not tolerate non domain specific complexities. If the needs of user friendly visual tools suitable for digital content creation, conceptualization, and activity oriented knowledge organization are not acknowledged, as opposed to the requirements of writing XML lines, it is hard to expect in the era of social learning that pedagogic knowledge transfer will comply with powerful e-learning standards. Claims to transparent nodal knowledge representations and orientation in the whole spectrum of mobile multimedia based e-contents are rightful expectations on behalf of learners anticipating positive learning experience. Analyses of the possible use-cases of the TinCan API specification point to the recognition that it extricates web based learning from the closed, content packaged "course conceptions" of LCMS based e-learning 1.0. Its extensions including potential refinements of activity tracking may pave the way for effective performance testing. The advantages of the modeling capabilities of the original LD approach and of the promising capabilities of TLA together with the xAPI specification circumscribe a more provident, Web 3.0 conception of LXD. Such a conception adapts to new self organizing and knowledge explorative roles of the learner, to the orienting, orchestrating activity of the "coach" and to the free use of web based tools and user generated content. The emergence and the expositions of the UXD conception confirm that in the open, collaborative 3.0 world of Digital Content Creation LXD is becoming an activity that shapes the space of learning opportunities, problems, motivations and interests recovering the ancient meaning of learning: "to follow and/or find the track".

Keywords: e-Learning Standards, Learning Experience Design (LXD), Learning Design, IMS LD, Experience API, TinCan, e-Didactics, Digital Content Creation, Educational Modeling Languages.

1 LEARNING AND DESIGN

Design is a fundamental human activity which has different connotations in the field of education. Educational Design, Instructional Design, Learning Design equally imply different associations and refer to different professional activities which supervene on the primary meaning of devising objects and courses of action. While Educational Design encompasses educational planning, the development of academic standards, curriculum design or improvement of the effectiveness of educational programs, Instructional Design aims at "translating principles of learning and instruction into plans for instructional materials, activities, information resources, and evaluation" [1]. Learning Design (LD, as a broad concept), largely in consequence of

learning and content management (LCMS) based e-learning technologies [2], is concerned more closely with planning the learners' and teacher's activities according to different teaching methodologies and models of pedagogic scenario. The introduction of LD in e-learning confirmed a basic methodological insight that any *delivery of instruction* can be analyzed and described in terms of the parameters of the Learning Environment, the Communication Services, the Roles of the participants, the Tools which are used, the Properties of learning contents, and the Activities of the participants of the knowledge transfer process. The very idea of providing a formal language that is based on a general meta-level terminology acted in the direction of standardization. The intention of finding a uniform way of description for the existing teaching methods predestined Learning Design for developing into an interoperable "de facto" standard (IMS LD). The specification, initiated originally by the Valkenburg Group of e-learning experts, looks back on decade of efforts to formalize meta-level description of an "unlimited number of pedagogical approaches" [3, p.v.] at a higher level of abstraction, called "pedagogical meta-models". [4]
The term "Learning Experience Design" (LXD), in turn, has surfaced only recently, with the issues of designing intuitively usable, learner-centered interactive interfaces for online learning. Its appearance can be considered a consequence of answering needs of the online market that signify the divergence of formal and informal learning. The learning habits that have intertwined with web 2.0 technologies and are often considered responsible for the separation of formal learning standards and learners' informal expectations [5] are rooted, however, more deeply in "man's natural craving for knowledge". For as *Comenius* already asked, "[w]ho is there that does not always desire to see, hear, or handle something new? To whom is it not a pleasure to go to some new place daily, to converse with someone, to narrate something, or have some fresh experience?" [6, p.43]

Changes in social learning habits in consequence of communication technologies are but one factor in the divergence of informal learning and formal educational standards. Pattern Design (PD), in the spirit of participatory culture, "was out of the recognition of a similar gap in architectural design". [7, p.3] Similarly to the pattern language movement in architecture which "intended to enable users to actively and directly design their own living and working spaces, in part by providing a common language"[8, p.27], PD "concerns the resolution of problems in their context" and intends to democratize learning design. [7, p.3]. Experience Design represents another factor, a *methodological* point of view and a corresponding *designer's* approach that assumes a user and community centered conception of intuitive learning. It places more responsibility on the learner in achieving her cognitive goals and expects the designer to place himself in her position anticipating her interactions relying on user feed-back already in the process of design. It concentrates on planned as well as spontaneous user experiences that are serviced by online *tools* and *services* which can be integrated on the web. Open Web Technologies as alternatives to plugins *foster, support,* and *encourage* autonomous learning. LXD can be contrasted with the idea of *delivering instruction* not simply because it is standing more on the learner's, than on the teacher's side, but rather for reconceptualizing the role of both of them. LXD considers the WWW itself as a learning environment providing meeting and market places of active learning and for self directed knowledge organization practices.

Since LD is considered as the most sophisticated specification elaborated for online learning it is reasonable to compare it with the approach of PD and LXD in the context of developing Mobile Multimedia-based Knowledge Transfer environments. [9] The following considerations reflect effective dilemmas the developers were faced with in such a project, called MMATT, [9] and are intended to shed light not only on the theoretical background of design decisions that were made but also on problems that are behind the development of new technological standards in the "Web 3.0 period of the second media age". [10]

1.1 Learner Centered Design and the Self Directed Learner

Until recently, education was a field where "design" as an intentional, systematic and reflective process implied paying more attention to planning *someone else's* actions and cognitive processes than in any other courses of human action. Depending on educational styles, especially in case of directive or factitive manners, it usually took the form of designing the steps of the knowledge transfer process and sequencing the activities of its participants *in place* of the learner. Autonomous, active learning gained momentum apparently as a result of the changing learning habits and technologies of web 2.0. However, learner centered educational conceptions which so readily allied with user centered design have a much deeper historical background than the technologically supported web 2.0 turn towards self directed social learning. *Maria Montessori*'s "house of children" or *Rudolf Steiner*'s "Waldorf "Schools" already gave the learners the freedom to plan their own activities and considered involving them in devising learning experiences more important than adult-imposed curricula. These schools initiated a change in the teachers' role who began to serve as *facilitators*, *motivators* and *evaluators* of the learning experience rather than knowledge resources, and acquired an additional responsibility to transmit capabilities to work on projects and in groups. Similarly, in current learner centered education the personal knowledge of the teachers comes into account in three different functions: as *designers* of problem spaces, contexts and asset rich set ups for the quest for knowledge, as *peers* helping out in predicaments with hints or interpretations, and as *performance evaluators* providing feedback and motivation.

Planning the learners' activities always called for different methodological approaches than devising the teacher's own activities, lesson plans, or designing learning objects, although one was never admissible without the other. From the point of view of learner centered design, however, the crucial difference consists in exchanging the perspective of stepwise activity planning to the design of properly composed environments and providing pointed solutions for user directed *co-creation* of knowledge. These environments consist of tools for self directed learners that are suitable for their own activity planning and knowledge organization not only for the teacher's course organization, for communication with the tutor or pre-designed delivery and reception of information. Learning is not "adapted" to the students' needs and capabilities by others, but they themselves become the organizers of their own knowledge work. Learner centered design assumes that the learners become independent problem solvers and active re/searchers of information. The autonomy of the learner makes it unnatural to exclude from the learning process the use of smart devices, online resources, and communication with peers. Several studies on next generation learning habits confirm that the difference between out of school informal learning attitudes and formal in school learning turns around the use of smart devices and the free use of rich web applications and the Internet of Things. The rich media capabilities of HTML5 are making the design and adaptation of user developed content and web applications easier than ever. The challenge of HTML5 based mobile learning trends led to the convergence of different professions and even to suggestions that teaching can be interpreted and practiced as an interdisciplinary field of design science. [11]

1.2 Modeling with IMS Learning Design

The IMS LD specification is based on an educational modeling language (EML) developed by the Open University the Netherlands (OUNL). [3] As a formal *process model* it represents abstract *learning scenarios* encoded in machine interpretable XML format, which can be played to learners by IMS LD compatible run time engines of Learning Management Systems. There are several expositions of its original "theater play" metaphor which lies behind its abstract description of instructional strategies in terms of Learning Objectives, Methods, Roles, Learning Objects, Services, Activities, Activity-structures and Conditions. [3, 4] It was proposed as a pedagogically neutral specification that supports teachers in *reusing* pedagogical strategies and Shareable Content Objects. Patrick Gallagher, senior advisor of ADL and NSF, points out however, that *reusability* did not prove to be as easily achievable an ideal of the e-learning community as it was expected. [12] Various reasons account for the disillusionment; among others context dependencies of content, the obsolescence of representation, the different levels of abstraction, granularity, and user sensitivity for the ways of "staging" the learning scenarios. Nevertheless, the idea of sharing patterns of LD is with us and is flourishing in various IMS LD independent general pedagogic forms. Gallagher, e.g., concludes that "defining abstracted models based upon applied instructional theories and pedagogies […] can support the building of model libraries that can function as design building blocks for learning experiences." [*ibid.*]

IMS-LD can be integrated with other standards such as IMS Question and Test Interoperability (QTI) or Learner Information Profiles (LIP). The inclusion of properties and conditions at Level B of the IMS LD specification made LD's activity sequences adaptable to Learner Information Profiles (LIP) to suit the needs and preferences of individual learners. Level C notification capabilities made adaptive sequencing and event-driven simulations possible. Koper, [13, p.14] reviews the original LD specific requirements and also those that are derived from the interoperability of standards such as Reusability, Formalization and Reproducibility. The requirement of *Completeness* among others „includes a) Integration of the activities of both learners and staff members; b) Integration of resources (learning objects and communication/collaboration services) used during learning; c) Support for both single and multiple user models of learning; d) Support for mixed mode (blended learning) as well as pure online learning." These requirements characterize the 'completeness' of LCMS based learning at a workplace or higher educational institution of the time. *Pedagogical expressiveness* means flexibility to describe all kinds of pedagogies without "biasing towards any specific pedagogical approach" such as competency based learning, project based learning, mastery learning, cooperative or problem based learning. *Personalization* implies the ability of being adapted to preferences, pre-knowledge, educational needs, portfolio and situational circumstances of users, where adaptation means that "the designer, when desired, [is allowed] to pass the control over the adaptation process to the learner, a staff member and/or the computer." [*ibid.*] *Compatibility* with both the IEEE LTSC standards and the extant IMS specifications was maintained as a requirement for the specification from the very beginning of its development. In the group of IMS specifications it became a reference framework for the computer supported application of EMLs.

Technologies surrounding IMS LD have come a long way on the roadmap of implementations of Learning Design obtaining support from such projects as UNFOLD (2004), TELCERT (2004), PROLEARN (2004), PROLIX (2005), from the Canadian LORNET, .LRN, JISC, or the EU IST funded TEN COMPETENCE and the TENCompetence Foundation.

In spite of all support, IMS LD was slowly and reluctantly adapted. It was criticized for various reasons. It was claimed that LD modeling is technically too difficult to learn for non-professionals and requires funding to ensure substantial cooperation of the e-learning expert and the knowledge owner. Although experiments have demonstrated that teachers can easily learn the technique [14], the question was whether they have time for, and are ready to invest energy into creating reusable LDs according to the specification. Several studies have examined the expressiveness [15] and the limits [16, 18] of the specification in order to facilitate its application in practice. Clearly, there were various non technical reasons for its slow adoption in addition to the financial considerations of LMS vendors concerning the cost of its adaptation as compared to the (relatively low) number of exiting IMS LD compatible materials. The academic world still gives more credit for publishing a textbook than for elaborating LD models (in a form not acceptable for publishers) and it is easier to create SCORM 1.2 compatible e-learning materials from textbooks than to design the didactic details of learning/teaching activities. As long as teaching is dominated by content delivery, 'learning as product' wins against 'learning as a process'. Cooperative e-didactics in which learners are involved in the development of learning models requires more participation and coordination on behalf of stuff members than simple lecture capture for example. From these "practical" points of view missing capabilities such as learner support, 'on-the-fly adaptation', or being editable at run time, do not even matter.

Paradoxically, by the time design science and e-didactics started to converge and developers addressed the technical problems holding back its wider use, IMS LD had became considered by some experts as "mostly dead", by others as a specification that deserves an "opportunity to rethink". [17, 18] In spite of its original intention of being pedagogically neutral it seemed to be associated too strongly with the e-learning methodologies of the world of monolithic LCMSs and the original idea of pre-designing the 'play' (both in its metaphorical and executable sense) as a formal process. Its basic idea apparently *was* pedagogically laden, because (i) it was derived not so much from *contextual* didactic considerations but from the available technology of computer assisted automation of learning management; and (ii) because it represented the *top down* approach of 'lesson plans' reflected in the e-learning 1.0 centered conception of the 'script' and the 'stage' serviced by the run time environment. It was extensible to co-operative and collaborative learning but the *autonomy* of the learner have remained limited. Altering the course of inquiry or the sequence of her activities "on the fly" in function of contextual factors, changing preferences, incoming information or emerging ideas require the extension of LD capabilities in the direction of next generation learning habits. The evolution of online learning and mobile technologies offer the participants of knowledge transfer opportunities to *co-create* and access content full knowledge architectures directly on the Web. As an information resource the Web is just too large and uncertain to foresee all of its effects on problem solving or on learning preferences and interests. Web Apps and online tools bring in new activities that *may not* and *cannot* be represented in the pre-designed course of actions neither as tasks nor as conditions partially for technical reasons partially because they cannot be foreseen. The online services sitting at our fingertips are not just "Resources" but interact with the learner in ways that influence the learning scenario positively or negatively, promoting the accomplishment of the original learning task, distracting from it, or even altering the learning goals. The delivery of content is not a challenge any more; instead, the selection of proper tools to organize the obtained information and personal learning design became the central issues. Open learning with the full spectrum of web resources and online tools bursts the very conception of exact pre-design. As long as there are no reasonably easy to use cross-framework tools for producing didactically transparent *domain dependent* online knowledge architectures it is not realistic to expect teachers to abstract their meta-models of learning/teaching according to a fixed, strict –no matter how powerful– specification. It undermines discovery learning, exploratory epistemology, and other inquiry based constructivist approaches such as problem based learning and the co-creation of knowledge. The issue is not the *expressiveness* of LD [15] but its *usability* in the context of new learning habits and educationalists' everyday practice. [20, 21] As a matter of fact, it was even raised retrospectively that IMS LD as a specification does too much. [22] It implies (1) a way of creating courses, (2) functions as an interoperability standard to exchange learning scenarios in a machine interpretable form, while it is intended to (3) serve sharing human pedagogical practices providing a modeling language. The three functions, especially in the era of Open Web, require alternative specifications and functional solutions at different levels of abstraction. The context and content dependent dynamics of web based knowledge organization implies the reorganization of the abstraction levels of EMLs since the level of activity management is too far from creating transparent structures of content management and navigation. (See Fig.1. below)

Another aspect of usability is the labor demand of creating models satisfying the IMS LD specification. If content dependencies of the dynamic context of problem solving or web research are taken into account the elaboration of detailed alternative didactic steps requires tantalizing work from the designer. He is not supposed to draw on unknown resources and can work out only alternative elements, versions and learning paths of *given* learning scenarios. If the alternatives lead him to intricate details of the subject matter he has to move to lower levels of abstraction, closer to Sequencing and creating Structure and Content. [Fig. 1.] Working at that level requires considerable skill and science to work out content dependent models as conditioned alternative learning scenarios at a design phase. He not only needs user friendly authoring tools pointed to work at this level, but corresponding IMS-LD aware LCMS capabilities. This is an area of deficiency for most LMS vendors who prefer to consider learning objects (LO) as static content aggregations. One alternative could be to create active learning objects which are able to manage their own activity structures but it conflicts with the principle that didactic steps should not be embedded in the LO for the sake of preserving the option of multiple instructions. Getting around the complexities of IMS Simple Sequencing in order to focus on activity and task management admitting multiple roles and collaboration is an advantage of the specification but confronting the lack of capabilities for structuring content, Web based activities and external tools usage is a serious problem. What is to be told at lower levels of abstractions may refer to dependencies of web content and activities that happen to be the hart of the subject matter. To abstract the essential life skill of years of teaching experience in terms of tasks, activities without a corresponding standard for content dependent activity structuring is not an easy matter and the IMS-LD specification gives little guidance concerning the integration of the extant standards. IMS supports integration with IMS QTI, but deeper integration with SCORM 2004 requires much more communication than a simple link to the SCORM player. SCORM 1.2 is more popular not just because it is simpler, and offers an easy way to leave navigation in the learning content to the learner. The TENCompetence project, however, solved SCORM 1.2 service integration with the IMS-LD player. [32]

If a social *knowledge market* does not emerge which values demanding meta-models as intellectual products teachers will rather tend to exchange their pedagogical practices verbally within small professional communities and personal learning networks. The didactic work invested to elaborate LD patterns awaits financial as well as academic recognition. The growing market of user created content already started to answer some of these expectations but is diverging from the first two above mentioned functions (1, 2) of the specification. Domain dependent content started to prevail in the form of HTML5 based (LD player independent) rich media content modules that are preferred, especially on mobile devices. The knowledge representation capabilities of LD and its LCMS staged “theatrical metaphor” seem to be passed by the rich supply of Web and Mobile Apps, that use games frames or knowledge management tools which include components of personal activity planning, business process management and performance evaluation. ‘Learning took to the streets’: the rich media of the World Wide Web became itself the stage. LTI™ compliant Edu Apps, let alone non-standard Mobile Apps, offer permanently growing knowledge resources that are becoming easily accessible. These trends of the informal educational market force reconsidering the ways of creating patterns of learning scenarios. Factoring the labor demand of LD specification in function of the actually available set of authoring tools one can detect considerable development in the last decade which will be briefly sketched in the next section. It must be noted, however, that there seem to be no further developments to transplant its modeling approach to describe the learning behavior of the self organizing learner in order to extract the patterns and learning paths of her Web research.

1.3 Authoring Learning Design *versus* Designing Learning Experience

Putting students at the center of the learning process as organizers of their own activities represents a preference for active, self-responsible learners and personal regard for individual effort that assumes a change in the goal and conception of instruction but does not exclude thinking –and designing– for someone else. More and more people create experiences and engineer interactions for others. Authoring multimedia presentations and digital content assumes working with the intended audience in mind; workflow or business process management is widespread technology just as the application of UML activity diagrams. In the intersection of various fields there is a common interdisciplinary research area with a focus of interest in the development of authoring and design tools for procedural and visual knowledge representation. [23] Mor and Winters argue for addressing the design challenge from multiple perspectives [24]. From that point of view LD is just one notation for education specific process management. From a wider perspective it is much more than that and one can evaluate its aforementioned three functions separately. It enabled that not only the learning objects could be shared but the activity patterns using those objects could also be exchanged. As an operationalizable specification it set interoperable input requirements for run time engines and LD players (e.g., Copper Core, SLeD), which have to be implemented in order to interpret the IMS-LD compliant XML input files. In order to make authoring LDs easier without programming experience two main strategy prevailed: (i) to disburden the users from producing the proper XML format and (ii) to assist them in designing pedagogical meta-models by human understandable representations.

1.3.1 Editing Learning Designs

Initially a set of criticism addressed the extensive and complex specification of the IMS-LD modeling language and the lack of user friendly LD editors. The Valkenburg Group Reference Architecture included General Purpose tools for some of its subsystems, but the development of IMS-LD reference runtime, Runtime Player, Repository and LD-Editor, as special tools, remained distinct tasks in addition to the generic tools. By now a whole range of different tools is available to design highly complex courses. [25] The reference implementation of an 'LD authoring tool', the RELOAD IMS-LD Editor, was the first pointed tool (not just an XML editor) for creating LDs satisfying the dual need of machine interpretable *and* human understandable activity management. Several JISC and EU IST funded projects (ALFANET, UNFOLD, ProLearn, Collage, OpenDock and Planet DR, LD4P, TENCompetence) contributed to its adoption and development and extension. In addition to the scheme-based RELOAD editor or the more handy CoSMoS [26] which provide full functions to edit all the three levels of LD, there are alternative high-level graphic editors like MOTPlus and the TELOS visual language and group work oriented environments to edit learnflows such as InstanceCollage. [27, 28] The economy of design in the spirit of the rule "Don't make me think" (unnecessarily) forced several attempts to take the course of visualization. Developing another alternative solution J. R. Dalziel stressed the importance of passing information across Acts and Tools, the importance of the introduction of user grouping, within-Act multi-learner synchronization, and more advanced sequencing and made the not strictly IMS compatible but LD 'inspired' user friendly architecture of LAMS2 [29] available. The new ReCourse, editor developed in the TENCompetence Project [30] saves Units of Learning in the IMS LD XML format, eliminating the import-export process of RELOAD. It is a Java Rich Client Platform desktop application which provides cross platform support with a native user interface. There are few practitioners reports on the use of ReCourse, however, the alternative tools and experiences with the earlier LD editors made it clear that if the needs of user friendly visual tools suitable for digital content creation, conceptualization, and activity oriented knowledge organization are not acknowledged, as opposed to the requirements of writing XML lines, it is hard to expect that pedagogic knowledge transfer will comply with the most powerful e-learning standards.

Issues of flexibility with respect to changing the learning course are also surfacing for a while in attempts of using LD in more informal learning scenarios. The Interactive Technologies Group at the Department of Technologies Universitat Pompeu Fabra recently addressed problems of planning learning paths and the needed level of flexibility. They not only point out that "unexpected situations [may] occur which would require a learning design to be modified on the fly […]", but that their methodology, called 'dialogic learning', "also entails that the participants are able to contribute in the (on-going) communicative design of the units. This situation demands a different approach to the current IMS Learning Design (IMS LD) implementations in which authoring tools are not integrated in runtime systems and where the designs need to be planned in advance." [31]

The usability problems that led to the development of more handy tools for designing, managing, and delivering online learning activities, such LAMS2 went parallel with trends of Learning Experience Design (LXD) that transplanted principles of usability engineering from the User Experience Designers' community into the field of technology supported e-didactics. Thinking in terms of the experience of others implies catering for diverse learner needs and characteristics and for the proper composition of tools needed to accomplish learning tasks and achieve cognitive goals. A special issue of the Journal of Interactive Media in Education was devoted to testing the LD in the context of collaborative learning using the 'Planet Game'. [33] The contributing research groups addressed not the technical problems of integrating LD with GBL rather used the collaborative situation of the game as a touchstone for current learning design approaches. An important result of these critical investigations is the recognition of the need for linking LD to *Domain-Specific Modeling.* [34, 35] With the increasing popularity of mobile games and edutainment, HTML5 based rich media and mobile learning trends challenge methodologists to join designers to create new flexible e-didactic solutions for m-learning. Burgos and Tattersall prognosticate that "[n]ew IMS LD-aware players will emerge, including micro-players allowing learning processes to be coordinated across mobile devices". [36] The ASK LD Toolkit and Mobile-LD-Player, e.g., came out during the intervening time promoting open learning on user selected mobile applications. [37] Claims to transparent nodal knowledge representations and orientation in the whole spectrum of mobile multimedia based e-contents are rightful expectations on behalf of learners anticipating positive learning experience. Delivery technologies may change and die while design principles converge. The need of designing interactions for m-learning may bring design methodologies developed outside the educational field closer to LD; and the use of smart devices might make different approaches to modeling learning activities converge in the form of suitable toolkits serving next generation learning experiences.

1.3.2 Learning Experience Design

The term ‘Learning Experience Design’ connects design principles of User Experience Design (UXD) to Interactive Media in the context of education. The conception of UXD, explicated in James Garrett’s reference work, by now has become an identity tag for the community of ‘information architects’. [38]. It can be considered as a design model offered for the web designer community consisting of different “planes” of design. The levels include Information Design, Interface Design, Navigation Design, Visual Design, Interaction Design, Information Architecture, and the model describes a move from the abstract (Objectives, User Needs) towards the concrete through the specification of Functional and Content Requirements. UXD incorporated design principles of constructivism and R.S. Wurman’s approach to Information Architectures [39] and paraphrased the term ‘user experience’ as ‘learning experience’ in the context of web based next generation learning. At the turn of the century, following Wurman, Rosenfeld, and Morville [40] Garrett articulated a “basic duality: The Web was originally designed as a hypertextual information space; but the development of increasingly sophisticated front- and back-end technologies has fostered its use as a remote software interface. This dual nature has led to much confusion, as user experience practitioners have attempted to adapt their terminology to cases beyond the scope of its original application.” [ibid.] Information architects became interaction designers and started to use cognitive tools such as conceptual graphing, card-sorting, agents and personas, role playing, and prepared not only demos but developed interactive programs. Web design using the “web as remote software interface” –or currently as a mobile interface– has pushed designers towards a unified field theory of design of e-content, knowledge architectures, social and educational tools. Models and problems of usability engineering and interface design became similar to non trivial problems of designing effective technology-based educational activities. [21] Diana Laurillard’s recent book argues from the teachers’ side that “teaching is now a design science. Like other design professionals –architects, engineers, programmers– teachers have to work out creative and evidence-based ways of improving what they do”. [11]

Our Mobile Multimedia-based Knowledge Transfer (MMATT) project supported by EU and the Economic Development Operative Program (EDOP 1.2.1) of the New Hungary Development Plan attempts to fill the collaboration gap between the two fields. [9] It is aimed at developing a knowledge market where members of the two communities can share their design knowledge and their tools for developing course models and educational patterns. Since mobile communication technologies and smart devices force the two fields to co-evolve, in the forefront of technology enhanced learning teachers and designers joined efforts to build on standards that are backed by both communities.

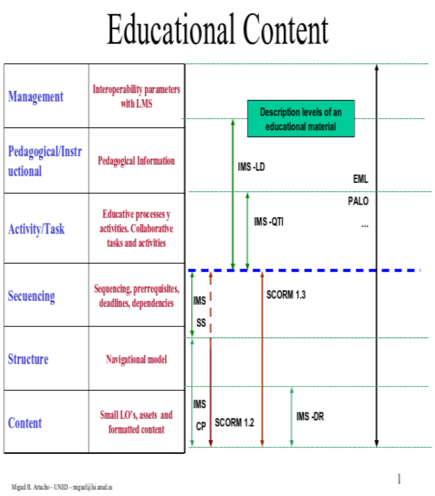

Fig. 1. Levels of Abstractions in LD [19]

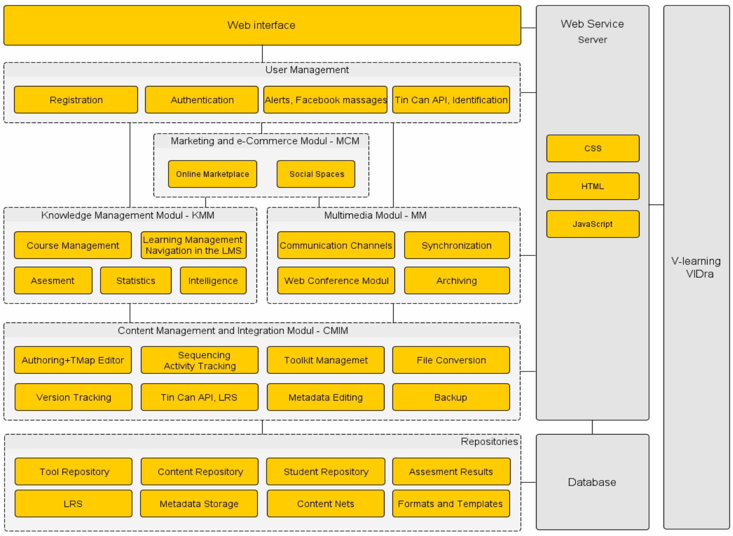

Fig. 2. The MMATT Architecture

2 EMERGING STANDARDS

Since Comenius's *Didactica Magna* advanced the idea of *universal education* and *'life long learning'*, educational standards have been changing in function of the goal of education, the social role and position of learning as well as of learning environments and technologies; however, the first *technological* standards of education appeared with the emergence of e-learning. The first generation of e-learning standards reflected the state of the art technology of learning management at turn of the century and banded together around Learning Object Metadata (LOM) and interoperable LCMS based learning management (SCORM). The 'course conception' of e-content which was lurking behind e-learning 1.0 strongly contributed to the success of SCORM 1.2 making the transfer of existing learning practices and textbooks to the framework learning management systems relatively easy, but by the appearance of rich media and mobile technology the limitations of the first generation of standards have build up more and more criticism and new approaches to sharing learning and teaching patterns. [7, 8, 11, 21] In the framework of our MMATT project [9] we intended to pull together a mobile toolkit supporting the exchange of new patterns of learning and educational design. The analysis of existing standards made it clear that their application to rich media structures in v-learning and activity streams in m-learning or in GBL feeds into serious design problems. Adapting them to video architectures consisting of time-line synchronized video-streams which were equipped with additional editable web content, and saving the activity structure so that the variations of learning paths with the interrupts of the stream can be re-used turned out to be highly problematic for example. Similarly, we have found that data feeds of community portals and social activities don't capture the richness of the original activity**.** We had to accept that apparently the existing standards were not designed for tracking v-learning and m-learning activities and for providing data about users operations, let alone about the didactic combination of Rich Internet Applications.

By the time we closed the research phase of the project and arrived at a wish list of a specification which seemed suitable for tracking web based activities and the design of didactically acceptable mobile learning patterns, Advanced Distributed Learning (ADL) announced the ADL Initiative in 2013 for the development of its new Training and Learning Architecture (TLA) [41] A decision was made that Rustici Software's 'Tin Can Api' would be further developed as the new *learning experience standard* (xAPI) which is to be transferred to a public standards body after version 1.0 will be completed in the Spring of 2013. [42] It has promised a well supported line of new standards correlating with our expectations. (Fig. 2. shows the planned layers and components of the MMATT architecture incorporating the xAPi.)

2.1 New Training and Learning Architectures and the Experience Api

The announcement said that "ADL is focusing its research efforts on a next generation online learning environment called the Training & Learning Architecture, or TLA. The TLA will provide learners with richer and more innovative learning experiences. TLA component capabilities will include experience tracking, content brokering, content 'understanding,' learner profiles, and competency networks. The experience tracking, which we refer to as the 'Experience API,' is the initial phase of the TLA." [43] The Aviation Industry Computer-Based-Training Committee (AICC) joined the initiative of ADL and the xAPI specification is now developed as a component of AICC's CMI-5, the next generation eLearning interoperability specification intended to replace existing AICC & SCORM specifications.[43]

XAPI (or 'Tin Can') is a service API for handling activity streams (e.g., JSON, or Atom) generated by different learning services. It exchanges information about the learning processes and links educational tools incorporating functions of activity tracking. It records the information about learning activities into various Learning Record Stores (LRS). It can work with multiple LRSs, admitting communication with LRS servers in the Cloud, with a corporate LRS, with the administrative information store of educational institutions or a private, personal record locker. Using its communication protocol the LRSs are able to talk to one another and the information can be passed between them storing and requesting activity streams. What the xAPI sets out are the parameters and rules for passing data statements about the user's learning activities from one application to the LRS and back, so that it can make sessions possible with other Apps. Its 'statement' sub-API tracks the learning records while Learning Activity Providers can use its 'state', 'agent profile', and 'activity profile' sub-APIs for extracting and providing information that is needed for creating dynamic web 3.0 learning environments. Any device can connect to the xAPI which records learning experiences which can take place outside or inside an LMS, collects information from mobile devices –automatically or at the learners prompting–, including reports of real world activities. The devices that are used can be camera-phones, sensometers, GPSs, even sonar devices or gyroscopes, enabling simulations, the combination of real life activities with rich media or augmented learning. The records from diverse sources which are feed to the record store consist of data about the type of the activities (e.g. reading an e-book, watching a YouTube or Khan video, flying with a flight simulator, participating in a webinar, communicating with one's Mentor, using Apps from Google Play) including the parameters of the sessions, their the duration, the achieved score, success or completion levels, assessments, etc.

A basic advantage of the xAPI (also called –somewhat misleadingly– "the next generation SCORM" [44]), compared with SCORM compliant learning management, is that it makes easy to go out to another application and come back returning to an open, incomplete learning activity. The data types of the contents of learning are not restricted by the SCORM data model since the learning contents and the activities are disaggregated from the LMS/CMS. XAPI can rely on custom learning management solutions but can also use web portals and other mechanisms to launch content from the web exchanging control data back and forth between content providers and the device that initiated the session. It is similar only from this point of view to SCORM specifications that wrap the content, launch the pocket and communicate with the management environment, however it is much simpler than SCORM, or IMS LD, and it does not require SCORM packages. On the contrary, it steppes around SCORM protocols allowing developers to write to the Api, hence, with a content broker it will be able to dynamically draw resources from different locations. Generating Tin Can statements and traceable learning data, App developers can utilize the xAPI, e.g., for tracking accomplishments or merit levels in serious games.

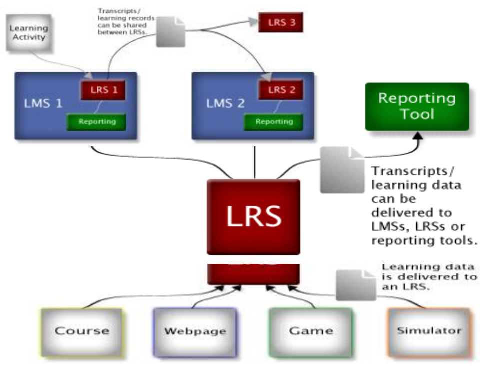

Fig. 1. xAPI communications with LRS (Source: Rustici Software)

Another advantage of xAPI is that to contrary to browser based applications it can be used outside the browser as a Native App, which promotes its adoption by vendors of mobile and smart devices. Thanks to being a native app, mobile activity creators have complete control over the user experience. Moreover, it makes easy to handle off line sessions of knowledge work since it does not have to be constantly connected to web. All xAPI needs is an occasional internet connection. It captures the offline reports of activities coming from the running applications and the sentences are stored as code statements in local storage and when the web connection is resumed xAPI is capable sending the statements back to the LRS (or several LRSs). As a result of the last two features one can take the recorded data on a mobile device with herself moving from one place to another or start web based activities, say watching a video, on a mobile device and complete them on a home computer. Taking advantage of the Cloud, hosted LRS (e.g., SCORM Cloud) users can even take their learning history with their business elsewhere. The accumulation of data makes data analysis possible in order to learn about the most effective training paths, to prepare statistics, or to carry out other forms of data analysis; hence, 'Big Data' evangelists will certainly appreciate its greater market penetration. It can be applied in correlation to business metrics or personal work-relevant learning experiences. In a corporate intranet setting, if the firewall does not let to send statements through the firewall, an internal LRS can serve the xAPI complementing business information systems with data about learning experiences. XAPI's 'WHO DID WHAT' (noun verb object) semantics is simple and transparent. It is based on the RESTful http protocol (GET, PUT, POST, DELETE) and the new 1.0 version of the specification already offers a relatively rich, extensible set of the core verbs that can be substituted in the activity statements in order to adapt it to different learning contexts and applications. XAPI moves beyond SCORM in that the defined verbs can go well beyond the data we currently get to track and represents it in a form that is easier to understand.

2.2 M-Learning Architectures

Since the MMATT's knowledge market will rely on user generated content it was an important factor that users be able to create xAPI compliant content, create, check and review activity statements. In spite of being in a development phase several authoring tool vendors adopted the specification and are making their products capable of producing "Tin Can Content'. (Articulate: Art Studio 13, Adobe Captivate, Lectora, Raptivity, Rapid Intake, Exam Builder, GoMo, Knowledge Guru, and frames for developing serious games). SCORM Cloud also offers user friendly tools called Tin Can Bookmarklet and a Statement Generator and Validator for reporting bookmarked web pages to freely specifiable LRS, and for creating and checking statements about learning activities. A public LRS statement viewer offers the possibility of reviewing them in a convenient form. These opportunities contributed to the decision that in the architecture of the MMATT framework a xAPI based activity management and a Topic Map (TMap) based course authoring and activity organizing tool is planned to serve the composition of individual or group activities and learning scenarios. Transparent nodal knowledge representations, like TMaps and activity orientation in the spectrum of mobile multimedia based e-contents simplify course development and promote the exchange of pedagogical patterns. These features of the learning architecture mean considerable didactic advantages from the point of view mobile knowledge transfer. Its extensions including potential refinements of activity tracking may also pave the way for effective performance testing.

2.3 Sharing Learning Paths and Designing e-Didactic Patterns

Neither the xAPI nor the TLA will be able to function as a specification for planning learning scenarios in the way as the IMS LD standard serves LD. They rather serve the execution of "on the fly" modifiable personal learning plans in the Web 3.0 period of the "second media age". Still, the xAPI may help to find better ways to achieve learning goals making data accessible about actual learning practices. Looking at the data differently, we gain insight about the ways a learning plan can be better designed. Learning from what the students actually do –using Diana Laurillard's wording again– teachers can "work out creative and evidence-based ways of improving what they do". The types of data we collect may influence what patterns we find and what meaningful actions we can take based on the data. The autonomy of the learners makes even more important to track her activities. Not because self reporting can be utilized for cheating as well – accessing SCORM code on the client side also made that possible– but because the teacher as a 'coach' is able to adjust his/her behavior accordingly. Actually, since all activities including teachers' assessments are ID safe and time stamped, certification may become more reliable, more detailed and what is more important can be based on monitoring what the learner has actually accomplished. Most LCMS is capable of tracking some aspects of learner activity but only within the LCMS and phishing useful data is not easy. Effective monitoring becomes more and more relevant because the autonomy of the learner surfing the 'Internet of Things' may lead to unforeseen results and to decision points where she needs guidance. This underlines the importance of *domain specific, content dependent learning design*. Tracking the students' activities more closely may also promote collaborative ways of finding and abstracting useful learning patterns. [45] Students themselves can share their records of visited web pages and learning paths, using Web Apps like Pearl Tree and the activity tracking of the xAPI to document their inquiry; they can collaborate with their teachers and peers on developing marketable learning experiences. Laurillard [11] also argues that "by representing and communicating their best ideas as structured pedagogical patterns, teachers can develop their professional knowledge collectively" what is also the goal of the MMATT project.

'Learner Profiles' (LP), the third TLA element, are not elaborated yet. All we know is that in addition to authentication and authorization they will include learner preferences and learning histories. In the MMATT project we are planning to use an external online ePortfolio App, as long as the LP specification of the TLA does not come out. The forth TLA element, 'Competence Networks' may also help specifying the preconditions of learning paths especially in case of Matura topics, but of course, organizations may also set the requirements of their professionals.

3 CONCLUSION

Both IMS LD and xAPI work on a "*who does what, when, with whom"* basis and focus on the organization management of learning activities. However, their approaches are related to different knowledge management conceptions. LD is more education and course model oriented, while xAPI and TLA are closer to the learner centered knowledge management conception and the interaction design needs of Web based LXD. Reconsidering the original goals of LD forces the conclusion that it is worthwhile to maintain its modeling advantages for capturing learning patterns separating issues of interoperability, machine interpretable course management, and the transparency of pedagogical meta models. The requirements of m-Learning are transforming learning and activity management opening the whole spectrum of multimedia based e-contents of mobile Apps making the Web a stage of activities where simplicity matters. "Don't make me think (unnecessary)" is a rule of the "second media age" that does not tolerate non domain specific complexities. The modeling capabilities of the original LD approach joined with the simple but powerful and extensible activity tracking capabilities the xAPI circumscribe a more provident, Web 3.0 conception of LXD. Such a conception adapts to the new self organizing and knowledge explorative roles of the learner, to the orienting, orchestrating activity of the "coach" (the teacher as a designer and coordinator of learning activities) and to the free use of web based tools and user generated content. The emergence and the exposition of the UXD conception in the context of education confirms that in the open, collaborative 3.0 world of Digital Content Creation LXD is becoming an activity that shapes the space of learning opportunities, problems, motivations and interests recovering the ancient meaning of learning: "to follow and/or find the track".

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