SUPPORTING THE NON-EXPERT IN THE AUTHORING OF PERSONALIZED LEARNING USING IMS LD

Tim Sodhi, Francis Brouns, Yongwu Miao, Rob Koper
Open University of the Netherlands, Heerlen

Abstract

This paper presents an alternate classification of the approaches employed in today's IMS LD authoring tools to support the engagement of non-experts in the design of instruction for today's e-learning. The classification is based on how the authors can approach the design task and the support that is afforded to them by the authoring tool. The paper presents the case for an approach based on educational scenario-based modelling, as best suitable to actualize a higher level of involvement on the part of the non-expert authors in the creation of personalized learning based on portfolios, and learner information. Additionally, based on the classifications, the paper proposes a set of features based on which today's crop of IMS LD tools can be classified, and a new generation of tools to support the non-expert authors can be modelled.

Introduction

The IMS Learning Design [1] specification has brought about many pedagogic benefits allowing educational processes to be modelled for subsequent sharing, critiquing, modification, execution, rating, comparison and evaluation [2]. LD allows encapsulation of knowledge using prescriptions from instructional design theory, examples from best practices in teaching and learning, or pedagogical design patterns, which can then be applied to develop concrete Units of Learning (UoLs) [3]. These UoLs can be seen as a general name for a course, a workshop, a lesson, etc. that can be instantiated and reused many times for different persons and settings in an online environment [4]. Teachers can avail themselves of the pedagogical flexibility offered by LD to create complex Learning Designs for a number of learning scenarios.

The IMS LD specification makes provisions to maintain information about the learner in the level B of the specification. The Person properties in IMS LD level B provide detailed information about the learners which can be used to adapt a learning design to the individual learner's needs. The form and structure of the Person properties where defined, can also be ideally used to model UoLs based on learner information [5] and learner portfolios [6] in order to tailor the courses to the needs of the learners.

The adoption of IMS LD in real education practice greatly depends on the provision of tools and processes capable of facilitating the creation of UoLs [7]. However, the provisions made in the specification have not led to successful implementations by teachers, instructional design practitioners, and other non-experts in the specification, due to the inability of this group to relate with today's IMSLD tools. Nearly all of today's IMS LD authoring tools are geared towards experts in the specification, not addressing the needs of non-experts and practitioners who are unable to relate to the technical formalisms of the specification[7-10]. The latter possesses the domain-specific knowledge of their chosen fields [11], but needs support with the modelling of their knowledge into pedagogically sound UoLs. It is clear, therefore that there is a deep conceptual gap between the needs of the non-experts and the support that is afforded to them by today's IMS LD authoring tools.

This paper presents an alternate classification of the approaches employed in today's IMS LD authoring tools in the design of instruction for today's e-learning, in order to exemplify the paucity of support for non-experts, and to inform the development of a new generation of IMS authoring tools that endeavour to actualize a higher level of involvement from the non-experts in the efficient authoring of pedagogically-sound UoLs. This level of involvement entails the provision of support and guidance with the application of learning design rules and designing education based on, amongst other didactical scenarios, learner information and portfolios.

Background

IMS Learning Design and Personalization

IMS Learning Design [1] was approved as an open technical specification in response to the paucity of a common notational system for describing educational processes, by a consortium of universities, system vendors, providers and other e-learning stakeholders. IMS Learning Design is the only available interoperable technology which enables multi-user learning scenarios to be represented in a variety of pedagogical approaches, such as problem-based learning, competence-based learning, etc. The IMSLD specification prescribes the form and structure of UoLs so that software applications may be created for their interpretation. IMS LD is however, not attached to any specific e-learning platform; it is "computationally complete" – which, for practical purposes, means that it can be directly used for deployment [12]. XML is used as the machine interpretable language in which the learning design and the concepts specified, are represented to be IMS LD compliant. The XML representations of the scenarios along with unambiguous pedagogic scenarios using a consistent and interoperable representation can serve as a reference point and resource for other researchers.

The specification employs a Theatrical metaphor to the design of educational processes. The design is expressed as *plays* in the *method* section which can consist of a number of *acts* that have actors in different *roles* performing an *activity* or a set of activities. The method links all the components of LD, coordinating roles, activities and environments associated with the activities. This emphasis on the theatrical metaphor in IMS LD aims to facilitate the practitioner to relate to the learning design process, allowing the practitioner to model the design of instruction on these lines.

In addition to the basic language constructs, referred to as level A [3, 13], the specification provides additional concepts to cater for more sophisticated process descriptions. IMSLD level B adds properties and conditions to the basic language constructs of level A, allowing more sophisticated control and types of learning. Level C adds notifications (email, and other services) to levels A and B. Of special interest with regard to customizing the learning design with regard to the learner profiles and portfolios as per the IMS LIP and IMS ePortfolio specifications [5, 6], is the IMS LD level B. Properties enable information about learner, roles and the state of the learning design to be maintained. Conditions enable designers to define rules that govern the behavior of the UoL as a whole and what gets presented to the individual learners and staff.

Properties are of two types, the *local* and the *global* properties, which can be *General*, *Person*, or *Role* properties [3]. Local properties have their scope within a single run of a UoL, whereas the global properties persist across multiple runs - Table 1.

Table 1 – IMS LD Level B

Property Type	Description
General Property (loc-, glob- property)	Attached to a UoL as a whole
Person Property (loc-, glob- property)	Attached to each individual user (learner, staff)
Role Property (loc-property)	Attached to all members of a role

Properties have many uses in the context of authoring of learning designs. Of specific interest in IMS LD level B are the Person properties that provide more detailed information about learners to adapt a learning design to individual needs and preferences [13]. The Person property structure (Table 2) is essentially the same as that used by IMS QTI for the results of tests and that in use by IMS LIP to handle the outcomes of activities. The latter, as a result can be used to store information that is generated during the run of a UoL to an ePortfolio repository.

Table 2 – Structure of an IMS LD property

Structural Element	Description
Name (title)	Text string that acts as a unique ID for the property
Type (datatype)	A data type like integer, text, etc.
Value	Value that can be set by the designer at design time, or can be assigned at run time
Identifier	A unique identifier that is an XML ID in the binding
Restrictions	Set by the designer, can constrain the number of permissible values
Metadata	Set to describe the property

The question then crops up, how can the author model knowledge into UoLs. According to Koper [3] , there are several ways to capture knowledge of the author, offering explicit guidance on how better to help students learn and develop. Based on Reigeluth [14], Koper [3] describes how *learning design rules* can be used to capture the author's knowledge and assist the author in developing the best suited learning design. A learning design rule describes the learning method that can be applied to a specific learning situation with a certain probability of success. Koper [3] proposed three categories of good rules: (1) (prescriptions) rules derived from *instructional design theory*; (2) rules derived from *best practices* in instructional design (examples); and (3) those based on *patterns* in best practices (patterns). These learning design rules form the underpinnings of the approaches implemented in today's IMS LD tools to capture the author's knowledge in UoLs that encapsulate pedagogically sound principles.

Paucity of tools for modelling personalized learning in LD

There is a common consensus amongst practitioners and in literature, that non-experts cannot design education using today's IMS LD tools [2, 7, 8, 10, 12, 15, 16]. The user needs to be fully cognizant about the kind of learning he wishes to author, as well as the underlying form and structure of the IMS LD specification before any modelling activity can begin. As a result, there is a deep conceptual gap between today's IMS LD authoring systems and the needs of the non-experts.

A plethora of general-purpose authoring tools have been designed for the IMS LD community. Tools like Reload [17], CoSMoS [18] and CopperAuthor [19] take a tree- and form-based approach to the editing of UoLs. Other efforts like ASK-LDT [20] and MOT+ [21] have added a graphical interface to the editing process, but are hampered in the lack of scope for support for all levels of IMS LD specification (ASK-LDT), or are too complex to be used by practitioners [10]. These tools serve as editors of the UoL rather than holistic design environments and are reference implementations of the specification rather than tools directed at non-experts.

In the context of modelling personalized learning, as per the discussion in the previous section, the author needs to model UoLs making use of at least Levels A and B of the IMS LD specification. With today's IMS LD tools, for instance, to create a UoL that takes into account the learner information, the author needs to be fully cognizant of the specification and in particular, the definition of Person properties, and how these can be bound to variables and properties in IMS LIP or ePortfolio. This level of engagement is not supported by any of the IMS LD tools discussed above. The author must resort to XML level editing to actualize and integrate properties into the Learning Design, which requires a high level of technical knowledge, in addition to an intimate knowledge of the specification.

As a result, for the non-experts, the authoring and design process using today's tools, where possible, is an overly complex and time-consuming task [22] which has led to limited acceptance from this community of the benefits that IMS LD has to offer [7, 10].

Reclassification of approaches for authoring UoLs

Though the classifications in literature contrast the IMS LD authoring tools on the basis of purpose and proximity to the specification [15], they do not make allowances for how design actually takes place during the creation of UoLs and the support and guidance that can be afforded to the authors during the process, and with the specification. In the face of the gamut of IMS LD authoring tools that conform to more than one of the classifications outlined above, a reclassification is sorely required to actualize a clear demarcation of the tools and form the basis for a comparison amongst the tools on their suitability for the non-experts.

Bottom-up approach

The bottom-up approach to the design of UoLs emphasizes upon the emergence of a learning design from the lower level details of the educational modelling process, without an underlying emphasis on the type of learning to be designed forming the basis of the modelling process. In bottom-up design with regard to IMS LD [7, 10], the design is aggregated from the individual processes by first specifying the individual parts of the design like activities, roles, environments, resources, etc. These parts are then linked together to form larger components like activity structures etc, which are in turn linked until a complete UoL is formed. The learning design eventually emerges from the piecing together of the individual processes.

The approach relies on either the authors being fully cognizant of the type of learning to be modelled, or on the tweaking of worked out examples, to create a UoL. The design activity is thus relegated at a lower level to a mere editing of the UoLs *in situ*. The author needs to be completely hands-on with the specification, with regard to the elicitation and description of the properties, variables etc, to tailor the UoL to the learner's needs based on the learner's information and portfolio.

The system provides at the most limited guidance in the application of learning design rules appropriate for the design task at hand. Consequently, the bottom-up approach can be envisioned to find its appeal with authors who have a clear idea at the inception of the process of how the design would pan out, as well as with authors who rely on worked out examples to adapt their courses. Fischer & Giaccardi [23] advocate that a successful implementation of this approach however, finds its implementation best with authors who have considerable prior design experience.

This is the approach apparent in all of today's IMS LD tools.

Top-down approach

The top-down approach to the design of UoLs emphasizes upon first the elicitation and selection of the type of educational scenario to be modelled, and based on that, provides relevant guidance throughout the design process. Systems based on this approach ideally provide for underlying learning design rules, used to model the author's knowledge into effective, quality UoLs. The top-down approach is significantly different from the bottom-up approach in the flexibility offered to the author with regard to the starting point of the design process, and the guidance and support afforded to the author at critical junctures of the design process. The process modelling can be envisioned as first selecting the approach based on learning theories, next creating the overall working learning design, and subsequently elaborating at each step, creating, for instance, an activity structure and populating the same with activities and learning resources relevant for the particular scenario, guided by design rules underlying the scenario to be modelled. Alternatively, the modelling activity could begin by elucidating the approach as before and then piecing together of processes (activities, resources) to build up to a working UoL, aided at critical steps by targeted support.

Here, the author defines the learning objective or the scenario at a higher level of detail by selecting from amongst sample educational scenarios encapsulating sound pedagogical principles and learning theories. Support and guidance is then provided to the author using learning design rules (templates of worked out examples, patterns in best practices) [3, 7, 24, 25] to model the author's knowledge into pedagogically-backed UoLs. Since the author is not overtly cognizant of the underlying constructs of the specification, UoLs personalized to learner information and portfolio, can be easily created by choosing and adapting from amongst existing and relevant worked-out examples or templates.

Allowing the design to proceed from the top-down aids the author to visualize problems at a higher level, and the related features as interconnected from the main overview, rather than compartmentalized [26]. This is particularly true for non-experts, who may need to start with an overview of the learning scenario to be able to understand the connection between all elements [27-29].The holistic approach thus, can find its appeal in the support of authors who are necessarily experts in their own domains, however are not quite experienced with the modelling of knowledge into UoLs, and thereby need support and guidance in the effective translation of their knowledge into pedagogically sound UoLs.

There are currently no IMS LD tools that support the author in the top-down approach to the authoring of UoLs.

Characteristics of the approaches

From the background of the current approaches to IMS LD tool design and our classification of the top-down and the bottom-up approaches discussed, we can summarize the salient features of these approaches. These are

(1) *Scenario-based modelling* – does the authoring tool take into consideration the underlying learning design theories and rules, providing support for the elicitation and selection of the type of educational scenario to be modelled, basis and structure of which are determined by underlying educational theories and best practice recommendations?;

(2) *Inception of the design activity* – how does the design activity commence? Can the author start from a blank Learning Design (*Tabula Rosa*) or does the tool provide support for working with and reusing templates, exemplars of existing Learning Designs etc.?;

(3) *Support and guidance* – does the tool offer support and guidance by providing and aiding with the application of learning design rules to effectively model the authors' knowledge into UoLs?;

(4) *Proximity to specification* – does the IMS LD aware authoring tool base itself on the use of metaphors, notations etc, that are close to the author's vocabulary, or are the specification constructs laid bare in the interface and structure?;

(5) *Authoring approach* – what authoring approach does the tool impose upon the author with respect to the design activity?

(6) *Target group* – who are the intended users of these tools? Are the tools designed keeping the needs of non-expert authors at mind, or do these tools cater to expert instructional designers?

The paper has presented an alternate classification of IMS LD authoring approaches implemented in today's IMS LD tools. Apparent from this classification is the lack of any general-purpose authoring tools employing the top-down approach in the support of the non-expert authors. The paper has elucidated the salient features of the approaches, which can form the basis to evaluate and exemplify the lack of support for non-experts in today's IMS LD tools, as well as serve to inform the development of a new generation of IMS LD tools.

Conclusion

The only pedagogically ignorant language for describing education, IMS LD makes provisions for the creation of personalized UoLs, amongst other didactical scenarios. Using level B of the specification to tailor the UoLs according to the learner information or portfolios, the author can create complex learning designs. However, there is common consensus amongst practitioners and in literature that today's IMS LD authoring tools are meant for non-experts in the specification. These tools are far too complex, requiring the end-user to be fully cognizant of the structure and formalisms of the specification. Furthermore, these tools provide no support to the non-expert author in the application of learning design rules to capture the author's knowledge in pedagogically-sound UoLs. Part of the reason for these shortcomings is the lack of a common understanding of the non-experts' needs for support in the authoring of UoLs for today's e-learning.

This paper attempted to bridge this gap by providing an alternate classification of the approaches to the authoring of UoLs, based on how the author can approach the design task and what kind of support and guidance is afforded during the design process. The classification attempts to demarcate the tools based on the support they offer the non-experts in the specification, and in that, could serve to form the basis for an extensive evaluation of the state of the art IMS LD tools. Furthermore, from the point of view of the non-expert authors, these features could serve to inform the development of a new generation of tools to actualize a higher level of participation of non-experts in the creation of learning based on - learner information and portfolio, for example.

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