Modelling a case study in Astronomy with IMS Learning Design

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Abstract: IMS Learning Design provides a counter to the trend towards designing for lone-learners reading from screens. It guides staff and educational developers to start not with content, but with learning activities and the achievement of learning objectives. It recognises that learning can happen without learning objects, learning is different from content consumption and that learning comes from being active. It recognises, too, that learning happens when learners cooperate to solve problems in social and work situations. In all this, it stresses that focus should fall on the learning in eLearning. This paper examines how IMS Learning Design (IMS-LD) and the current generation of IMS-LD based tooling can be used to model an eLearning case study in Astronomy, hosted by a workshop at ICALT 2006.

Keywords: IMS Learning Design, authoring tools, instructional design

1 Background

Significant investments have been made by universities, colleges, distance learning providers, and corporate training departments in the area of eLearning. Moving from early, tentative use of static HTML pages on web sites, the use of the internet as a delivery technology for education and training is now commonplace, with both distance and presential learning providers exploiting eLearning in their offerings. A standards-based IT infrastructure is in place in educational institutions around the world, simplifying the delivery equation and opening the doors to mainstream, large-scale, web-based education. Many different Virtual Learning Environments exist, including significant contributions from the open source community. Above the underlying IT-standards, rest a significant number of eLearning standards, specifications and reference models, designed to improve the interoperability between systems and remove islands of eLearning.

However, some have expressed uneasiness with eLearning, and are investigating how new information and communication technology developments, particularly in the area of collaboration and cooperation, could be brought into eLearning offerings.

The IMS Learning Design specification (IMS-LD, 2003; Koper & Tattersall, 2005) is an open specification, freely downloadable, maintained by an international consortium of universities, system vendors and learning providers. At the heart of the IMS-LD specification is a model which underlies many different behaviourist, cognitive, and (social) constructivist approaches to learning and instruction: People act in different roles in a teaching-learning process. In these roles, they work toward certain outcomes by performing learning and/or support activities within an environment, consisting of learning objects and services to be used during the performance of the activities. The approach separates learning objects and services from the educational method used in the unit of learning. Put succinctly, IMS-LD allows instructional designers to say who should do what, when and with which support facilities in order to reach learning objectives.

IMS-LD provides a notational system to describe ‘Units of Learning’ (UoLs), an abstract term used to refer to any delimited piece of education or training, such as a course, a module, a lesson, etc. The notation is capable of describing a wide variety of instructional models, or learning designs, such as Competency Based Learning and Problem Based Learning (Koper & Olivier, 2004).

The specification provides a framework of elements that can be used to describe, formally to support machine processing, the design of any teaching–learning process. The creation of a UOL involves the specification of the learning design and also the bundling of all associated resources, either as files contained in the unit or as web references, including assessments, learning materials and learning service configuration information.

Using the specification, collaborative processes can be modelled in which multiple learners, acting in various roles, using various learning objects and services work towards the attainment of learning objectives. This ‘learning flow’ is described using the concepts from the IMS-LD specification, and becomes itself a resource to be interpreted by an IMS-LD-aware player (Vogten & Martens, 2005), able to be shared and re-used with others. Once a learning design has been set up on a runtime system, the player uses the method to make the appropriate activities and environments available to the people playing the various roles. Through this, it coordinates and synchronises multiple learners as they work through a learning design

The IMS-LD specification was released in early 2003. Since then a number of tools supporting the language have emerged, books, special issues of journals, a number of articles, and also projects dedicated to the implementation, use and promotion of the specification (Botturi et al., 2008; Daniel Burgos, 2007; Daniel Burgos & Griffiths, 2005). In this paper, we will not describe the specification one more time. However, we will focus on some very specific issues concerning this case study modelling.

2 Modelling the scenario

The approach adopted makes uses of the role of teacher, and a role for each of the teams, Team A and Team B. The teacher is assumed to assign the students to one or other of the teams (to one or other of the roles). Figure 1 shows a diagram with the learning flow amongst the different roles (Fig. 1).

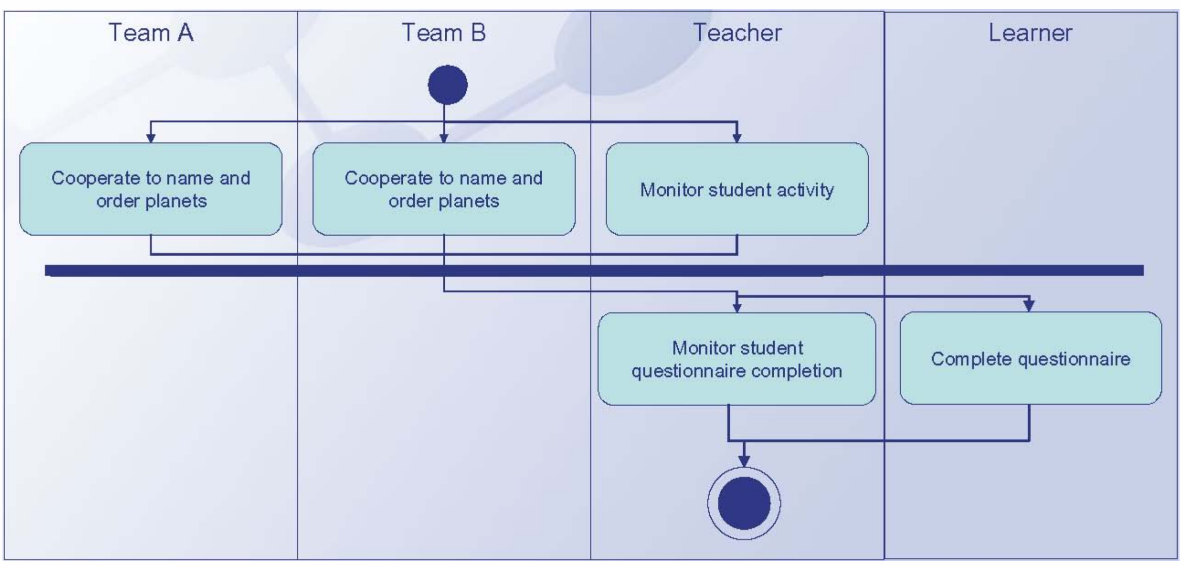

Figure 1. Diagram of the case study in Astronomy showing the different roles

The case study is divided into two Acts. The first act covers the team-based activity of cooperating to understand more about the naming and ordering of the planets, with the teacher offering assistance. This Act is completed when the teacher sees fit. The second Act has an individual activity for the students to make the associations, with the teacher monitoring the activity, declaring a winner and completing the unit of learning.

A learning activity entitled “Cooperate to name and order the planets” is defined, together with a learning activity entitled ‘Complete the questionnaire’. Two support activities are defined, “Monitor the student collaboration” and “Supervise completion of the questionnaire”.

Extensive use is made of Environments containing Learning Objects and Services. The expert interviews are seen as Learning Objects. The forum is an IMS-LD Conference of type ‘asynchronous’ and the chat rooms a Conference of type ‘synchronous’. Both the role of Team A and Team B are participants in the forum, as is the Teacher role. In this way all participants in this learning process can make use of the forum. One chat room is associated with each of the teams so that only intra-team communication is possible. In the worked out scenario, the teacher has not been granted participant or observer rights so that the chat is essentially private to a team (this could be modified so that the teacher is afforded a window on the interaction).

Two Activity Structures are defined to reflect the different situations of Team A and Team B. Each contains a reference to the learning activity of “Cooperate to name and order the planets”, and to the environment containing the shared forum service. In addition the Activity Structure for Team A has a link to an environment containing Team A’s Expert Interview and Team A’s chat room. Similarly, the Activity Structure for Team B has a link to an environment containing Team B’s Expert Interview and Team B’s chat room. In this way the cooperation and competition is facilitated.

In addition to participating in the forum, the teacher is given the opportunity to set a property indicating that the first Act should end. Once it is set, the flow of the process moves onto the second act where each user provides an answer (e.g, via an IMS-LD locpers-property, a type of private and internal variable) to the ordering and naming question. The teacher is provided with a view on these answers (via the monitor service) together with a mechanism to end the process and declare the winner (via a feedback-description shown on completion of the second act and containing the value of a property through global elements in so-called IMS-LD content).

3 Operationalisation

The above Unit of Learning was created with the Reload LD Editor (Bolton, 2006) (Fig. 2) with some additional low detail added with XML Spy (Altova, 2006). Currently, Reload LD Editor is a low-level authoring tool that provides a basic infrastructure for Levels A, B and C of IMS-LD. Others could be used, e.g, Cosmos (Miao, 2005). However, there is no integrated system and-or tool which can describe the relation between a Unit of Learning and the global elements of the files type IMS-LD content. Therefore, a text-based regular editor is needed to make such these connections.

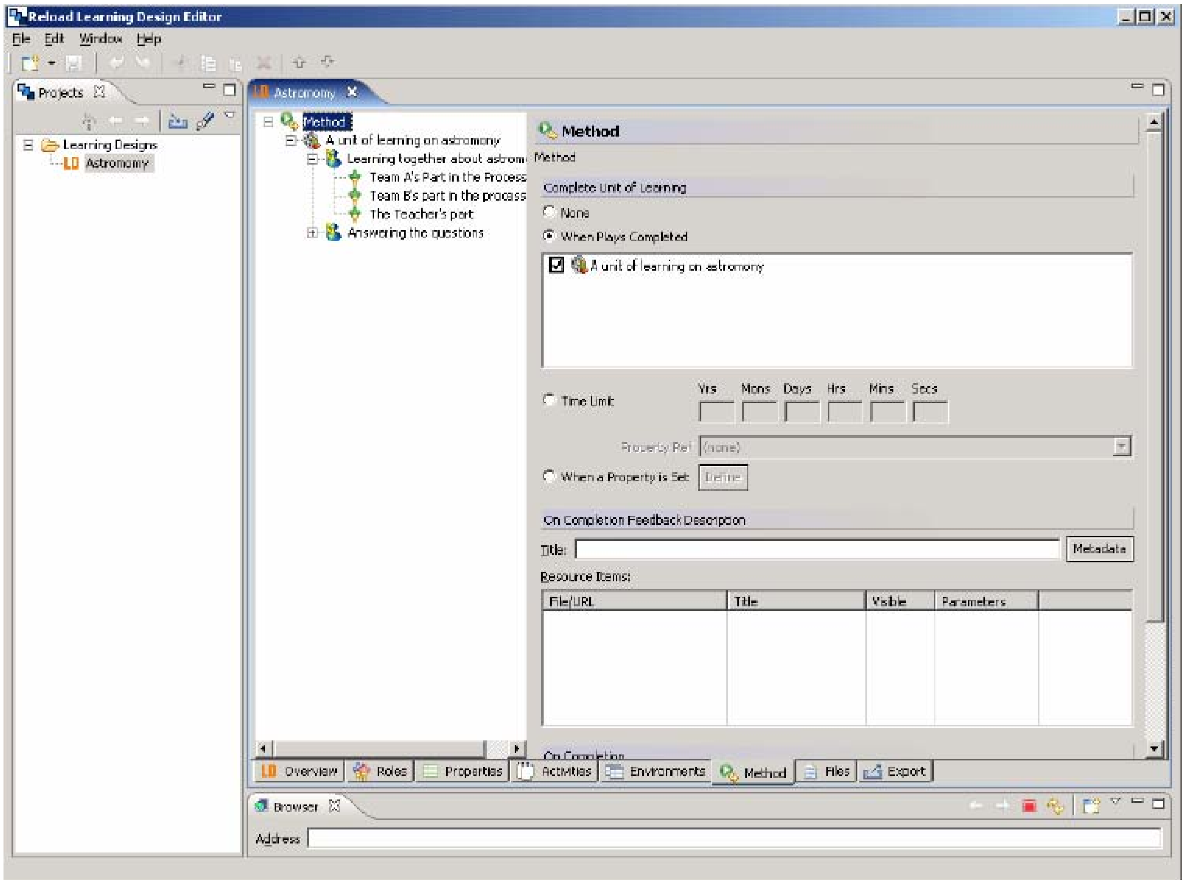

Figure 2. Reload Editor as the authoring tool for this case study

Once a Unit of Learning has been exported as a Zip file, it can be uploaded into a CopperCore (Vogten & Martens, 2005) based environment and played using a player such as the default player which accompanies CopperCore, or the SLED player (OUUK, 2005). Using administrative facilities, a run of the Unit of Learning is created and individuals are manually associated with a role (Teacher, Team A or Team B). Currently, there are other resources to make this setting. For instance, the .LRN Learning Management System (DotLRN-Project, 2006) is pointed out to run the three levels of IMS-LD, as well as there are several services already integrated in it (i.e, forum). A similar framework can be set up with netUniversité (Pacurar, 2005), and others are coming (e.g, the SUMA Project, which develops an ontology based viewer of IMS-LD Units of Learning).

Once this role allocation has been carried out, individuals can assess a web-player, with the flow of activities being arranged by the underlying engine.

The setting of properties by the teacher is supported in the current version of CopperCore, with the user interface control being generated from the type of the property (e.g, Boolean leads to combobox).

The monitor service, through which the teacher is able to follow the students' attempts at the questionnaire, is implemented within the player which accompanies the CopperCore engine. Further service integration into CopperCore-based environments has been the topic of R&D (McAndrew et al, 2004) and a loose level of integration has been achieved with Moodle. Through this integration, Moodle's forum services are used to facilitate the inter-team cooperation, including the teacher participation.

At the time of writing, no chat service has been integrated with the CopperCore Service Integration layer. Some further development is being carried out by the TENCompetence project (www.tencompetence.org).

One final point to mention is that the questionnaire could be implemented as a QTI item (see http://www.imsglobal.org/question/qtiv1p2/imsqti_asi_bestv1p2.html#1409410 for a drag&drop example in this domain). In this case the CCSI integration of the APIS QTI engine and the CopperCore LD engine leads to a multi open-technical specification scenario, in which the first steps to the harmonisation of specifications have been taken.

All these services (i.e, monitor, forum, chat) are used by different roles. While Team A and Team B can post in the forum and make use of the text chat, the Teacher role is the one who additionally makes use of the monitor service to track the users´ performance. (S)he is also the only one who can close the discussion part of the case study to move on (Fig. 3).

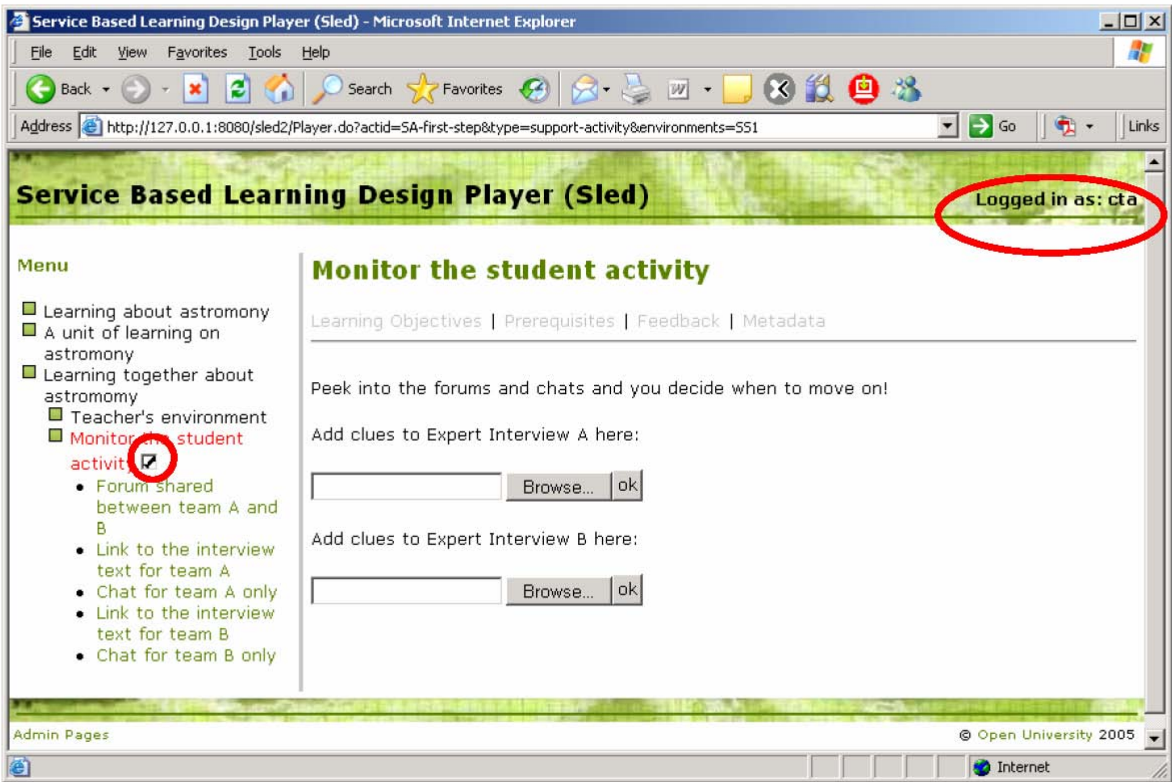

Figure 3. The Teacher decides when to close the discussion phase and move on

4 Observation

Opportunities for observation or monitoring have been incorporated into the design. First, since the teacher is also a participant in the forum, s/he is able to observe events. Had the choice been taken to offer the teacher insight into the chat rooms, this could have been modelled either by making the teacher a participant, or an observer (Fig. 4).

```
<IMS-LD:environment identifier="env-forum">
  <IMS-LD:title>Discussion Forum</IMS-LD:title>
  <IMS-LD:service identifier="service-forum" isvisible="true">
    <IMS-LD:conference conference-type="asynchronous">
      <IMS-LD:title>Forum shared between team A and B</IMS-LD:title>
```

```
        <IMS-LD:participant role-ref="Team-A" />
        <IMS-LD:participant role-ref="Team-B" />
        <IMS-LD:participant role-ref="Teacher" />
        <IMS-LD:conference-manager role-ref="Teacher" />
        <IMS-LD:moderator role-ref="Teacher" />
        <IMS-LD:item identifier="item-forum" identifierref="resource-forum" isvisible="true" />
      </IMS-LD:conference>
    </IMS-LD:service>
  </IMS-LD:environment>
```

Figure 4. Definition of the forum service to be shared by Team A and Team B, and monitored by Teacher

Further observational facilities are provided by the use of IMS-LD's monitor service when linked to specific properties (eg responses to questions) for particular roles.

In terms of the way in which observations can be used to modify the activity's progress, possibilities can be included in the design to have activities, acts, etc. completed when a value is set. This can be as simple as having a flag be raised when a member of a particular role sees fit (as illustrated in this example), or more complex, like conditions in which average scores or numbers of users completing can trigger further events.

On the other hand, the use of learner traces is an active area of R&D (Tattersall, 2005). The example worked out above includes only limited traces due to the rather skeletal IMS-LD Method section and an as yet unexplored area of R&D is the use of traces of interaction with IMS-LD services.

5 Re-use/adaptation

The Unit of Learning can easily be turned into a template by modifying the resources to address a different topic (some changes to activity title and meta-data may also be necessary). In essence the Unit of Learning could be used for many different areas.

One interesting challenge with respect to the approach is to generalize to several teams depending on the cohort size. As the approach stands, the number of roles is fixed, but a solution which allowed any number of teams (perhaps incorporating a maximum number of team members) would clearly require a different approach.

6 Discussion & Conclusion

During the first years of experience with the specification, a number of issues have been identified to be addressed as its use scales up. We believe the following trends will likely emerge:

- The tooling used for creation of UoLs will likely less directly reflect the concepts in the specification and will tend more towards those of educational practice. As a result, templates will likely emerge which can be used by instructional designers as a starting point for modification and tuning.
- Greater harmonization between eLearning standards will occur following that seen between IMS-LD and the IMS Question and Test Interoperability specification.

- A tighter integration of design-time and run-time perspectives on IMS-LD will occur, so that designs can be critiqued and improved on the basis of log data (Barré et al, 2004).
- A broader run-time integration of components in an eLearning Service-Oriented architecture and, due to this, a larger variety of communication and collaboration able to integrated into learning processes, including forums, chat facilities, wikis, and games (i.e, online, multi-user, multi-role).
- New IMS-LD-aware players will emerge, including micro-players allowing learning processes to be coordinated across mobile devices.
- IMS-LD will find use not only in formalised, designed approaches to learning, but also less formal ones, typified by work in Personal Learning Environments (Liber, 2005). IMS-LD's role here will be in providing post-hoc descriptions of learning processes, allowing unplanned sequences of activities to be described and shared in an interoperable manner. The work of Rasseneur, Jacoboni, & Tchounikine (2004) on learners' appropriation of curricula for their own ends is interesting in this context.

On the other hand, there are two major issues concerning modelling with IMS-LD (D. Burgos, 2008): 1) there is a need for high-level visual authoring tools. Nowadays there are two types of tools: effective but too technical, even for technical profiles; and simple to understand but not powerful, since they usually deal with the very basic Level A. The creation of UoLs should be as far as possible from technical requirements or the underlying elements, components or structure. A more visual approach would encourage the understanding and use of IMS-LD in a broader sense by target groups. Technical low-level editors should live along with the visual high-level ones, though. And 2), any authoring tool should allow for an integrated modelling process, working within the manifest, the resources and the required external XHTML files with a common, single interface. It should allow for dependencies and ease setting of properties. This is a hot challenge, not possible yet.

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7 References

Altova (2006). XML Spy Editor. Accessed online on Dec 18th, 2006 at: http://www.altova.com

C. Tattersall, J. Manderveld, B. Van den Berg, R. Van Es, J. Janssen, and R. Koper (2005). Self organising wayfinding support for lifelong learners, *Education and Information Technologies*, vol. 10, pp. 111-123

D. Burgos & D. Griffiths (2005). *The UNFOLD Project. Understanding and Using Learning Design*. Heerlen: Open University of The Netherlands.

D. Burgos (2007). Special Issue on Adaptation and IMS Learning Design. Editorial. *Journal of Interactive Media in Education*.

D. Burgos (2008). Extension of the IMS Learning Design Specification based on Adaptation and Integration of Units of Learning (Extensión de la especificación IMS Learning Design desde la Adaptación y la Integración de Unidades de Aprendizaje). Leganés, Madrid, Spain: Doctoral Thesis. Carlos III University of Madrid.

D. Rasseneur, P. Jacoboni, and P. Tchounikine (2004). Using and Enhancing a Normalized IMS-LD Description to Support Learners in their Appropriation of a Distance-Learning Curriculum, presented at IEEE International Conference on Advanced Learning Technologies (ICALT'2004), Joensuu, Finland

DotLRN-Project. (2006). DotLRN. Accessed online on June 22nd, 2007, at: http://www.dotlrn.org/

E. Pacurar (2005). netUniversité.

H. Vogten and H. Martens (2005). CopperCore. Accessed online on June 8th, 2008, at: http://www.coppercore.org

IMS-LD (2004). IMS Learning Design Specification. Boston: The IMS Global Learning Consortium.

L. Botturi, D. Burgos et al. (2008). Comparing Visual Instructional Design Languages: A Case Study. In L. Boturri & T. Stubbs (Eds.), *Handbook of Visual Languages for Instructional Design: Theory and Practices*.

O. Liber (2005). Personal Learning Environments Shifting the Locus of Control, presented at Open Source VLEs: The Next Generation, York.

OUUK. (2005). Sled player.   Accessed online on 13th, 2006, at: http://sled.open.ac.uk

P. McAndrew, R. Nadolski, and A. Little (2005). Developing an approach for Learning Design Players, *Journal of Interactive Media in Education (Advances in Learning Design Special Issue)*, vol. 2005/14.

R. Koper and B. Olivier (2004). Representing the Learning Design of Units of Learning, *Journal of Educational Technology & Society*, vol. 7, pp. 97-111.

R. Koper and C. Tattersall (2005). Learning Design - A Handbook on Modelling and Delivering Networked Education and Training. Heidelberg: Springer Verlag.

V. Barré, C. Choquet, A. Corbière, and S. Iksal (2004). Usage Analysis in an e-Learning System: LD Representation Significance, presented at ICALT 2004, Joensuu, Finland.

Y. Miao (2005). CoSMoS: Facilitating Learning Designers to Author Units of Learning Using IMS LD. In C. K. Looi, D. H. Jonassen & I. Mitsuru (Eds.), *Proceediongs of the International Conference on Computers in Education* (pp. 275-282). Singapore: IOS Press.