

LearningMapR: A Prototype Tool for Creating IMS-LD Compliant Units of Learning

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Abstract:

This article demonstrates and discusses a model to help instructors select appropriate designs from learning design repositories for courses they are developing. We describe the LearningMapR: A prototype pedagogical design tool being developed as a first step toward an IMS-LD-compliant authoring system. This tool's output is a Unit of Learning [UOL] containing storyboards, placeholders for content, and IMS-LD compliant templates and exemplars that are chosen from an illustrative set developed for the project. Based on collaborative work with the University of Oxford and using tools such as Reload as the base, we intend to create a 'teacher-friendly' tool for instructors to create UOLs.

Keywords: Pedagogy, Learning Design, Authoring, Templates, Design tool, Content Package.

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1 Introduction

The IMS Learning Design [IMS-LD] specification [2] offers tremendous potential for providing sharable, interoperable resources for instructors and instructional designers, in the form of reusable designs for units of learning [UOLs] that meet a wide range of instructional goals. For this power to be realized, however, effort needs to be focused on developing conceptual documentation and tools for instructors to use in accessing, adapting, and in further developing such reusable descriptions and designs.

The chapter by Gorissen and Tattersall (2005) describes how a UOL can be modelled using the IMS-LD specification. Using part of the "What is Greatness?" use case described by James Dalziel (2003), the authors provide text descriptions and screen shots from a player application running the educational scenario. In this way they try to help the reader conceptualize both the specification and the runtime consequences of design time decisions. This worked example shows the use of multiple roles in a collaborative learning situation, a learning service, properties and conditions, advanced completion rules, the showing and hiding of content, and global elements. The illustration of these features is important for users who want to instantiate UOLs using the IMS-LD specification – a critical next step in moving from specifications to the creation and execution of valid UOLs. These UOLs will need to be available when the next generation of [IMS-LD compliant] learning management systems are developed.

The fact that the IMS-LD specification expands opportunities for re-use of learning designs by enabling interoperability among compliant learning management systems is what makes it so powerful (Buzza, Bean, Harrigan & Carey, 2004). The true value of a UOL, however, lies in the pedagogical strength of the learning design it instantiates. The specification itself does not help course authors to conceptualize the instructional design process or the pedagogical features of effective instructional units; it merely provides a consistent means of describing those units. The task of identifying what learners and instructors should do, in what sequence and configuration, to meet a given instructional objective, and the content resources and learning tools they should use to do so is not trivial. Also, being able to recognize and select a learning design as appropriate for meeting particular learning objectives and instructional challenges requires considerable pedagogical analysis. This leads us to distinguish the following elements required for taking full advantage of IMS-LD:

- A learning design, understood informally as an instructional process and the rationale for choosing it in particular contexts; and
- An LD representation of the design, contained within a UOL which instantiates the design with specific content;
- The LD representation can be used as a tool for formalizing and facilitating the development of instructional processes, a way of indexing and searching on

designs, and a way to implement support for the delivery of the design in a UOL.

Effective learning designs are a valuable resource in their own right, both in terms of understanding how and why a particular UOL works and in terms of re-use of the design in other instantiations with different subject content. To fully realize the potential for teachers to re-use learning objects and designs that might be available through a repository, instructors must be able to determine which designs will serve their needs and purposes. The starting point in supporting teachers' uptake of what IMS-LD has to offer must be pedagogically focused around the designs which an LD representation formalizes – e.g., we need to support teachers in mapping out their course by identifying instructional challenges and by assessing appropriate uses of class time and independent student learning time, and then provide guidance toward appropriate instructional strategies. This guidance might include pointers to effective learning activities to engage students, as well as suggested activity templates and exemplars from which to choose.

2 Collaboration in Developing Design Wizards and Content Packages for UOLs

The LearningMapR will be based on an interface to the Reload content packaging tool called the Wizard Construction Kit Extension for Reload [WCKER]. The WCKER, developed at the University of Oxford, was conceived as a tool for building wizards to guide teachers through the content packaging and learning design process. These wizards would provide guidance at the initial stages of online course design by assisting in structuring content, but they were limited in that they would not help instructors to design learning activities through which students can engage with the content. Our part of the collaboration with Oxford involved developing the LearningMapR process, both conceptually and in terms of technical specifications for an IMS-LD compliant system. We envision instructors using a tool interface which has been customized to their instructional context. By necessity, this is not "pedagogically neutral"; for example, the design process used within the initial version of LearningMapR is based on the T5 model of instructional design, employed at the University of Waterloo (Salter, Richards & Carey, 2004). While some of our comments below are specific to this particular instructional model, the long-term intent is to allow customization to other approaches. [3]

The T5 model emphasizes Tasks (learning tasks with deliverables and feedback), Tools (for students to produce the deliverables associated with the tasks), Tutorials (online support/feedback for the tasks, integrated with the tasks and tools), Topics (content resources to support the activities) and Teamwork (role definitions and online supports for collaborative work). Learning tasks require students to engage with the course content to produce a deliverable artifact. The deliverables and feedback to these deliverables are the primary vehicles for learning. A basic principle of the T5 model is flexibility to allow for re-use of learning materials, such as textbooks and other [e.g., digital] learning objects. The

T5 model guides the instructor in the design of learning activities, supports reuse of resources, and helps make the instructional design and its rationale apparent to students.

Key features of the LearningMapR are that it will:

- Not require instructors to become experts in instructional design;
- Provide a framework for instructors to map out their course;
- Embed instructor-friendly representations of pedagogical models [such as T5]
- Identify different ways to use teaching time (e.g., content delivery vs. coaching)
- Maintain the textbook as an important resource in support of learning tasks;
- Provide recommendations, exemplars and templates for learning tasks;
- Be IMS-LD compliant and result in UOLs that are IMS-LD compliant

The LearningMapR incorporates a process that will allow instructors to develop instructional strategies based on the learning outcomes for a particular UOL. Moreover, instructors will be able to map out sets of activities for a single Topic, a module, or an entire course of study. They will end up with instructional strategies, activities and content structures that address what they want the learner to *know* and *do* for a given Topic, and that are appropriate for addressing particular instructional challenges that they may specify. Some instructors will recognize the value of this process in refining their teaching strategies; others will - at least initially - regard the process as necessary overhead in order to easily locate relevant resources to incorporate in their UOLs. This implies that the LearningMapR must be planned around two uses of LOM - as an index into reusable learning resources and as an index into learning designs and information about them. Within the LearningMapR, a UOL is considered to be a subset, or building block, of a complete course of study. This level of course structure is approximately equivalent to a module, a unit, or a chapter in a text book. Within each UOL there will be a set of Topics to be covered. For each Topic, some combination of Tasks and Content planning suggestions are offered as an instructional strategy, based on the instructor-defined cognitive outcomes and instructional challenges. These strategies are ones that have been found to be successful previously. Each of the Tasks may include Tutoring [i.e., feedback opportunities] and Teamwork [i.e., collaboration with peers] components. Content planning suggestions relate to the complexity and the quantity of resources [e.g., textbook,

lecture material, and/or learning objects] presented to students.

3 How Instructors will use the LearningMapR

There are two core components to the LearningMapR. The first will help instructors define what they want the learner to *Know* and *Do* as they cover a Topic within a UOL. To provide clear guidance in this definition process, we have chosen the revised version of Bloom's taxonomy (Anderson & Krathwohl, 2001) as a theoretical foundation for the LearningMapR (see Table 1) [4]. This model defines six different types of learning objectives based on what learners should be able to do cognitively with the content they are learning. Under each type of learning objective there are two or more sub-categories of cognitive activities in which students can be engaged as they cover a Topic. Since it was first published in 1956, Bloom's Taxonomy of Educational Objectives has been extremely influential in the research and practice of education and it is likely the most widely used taxonomy today (Slavin, 1999; Clark, 2000). Within this approach, cognitive objectives are categorized from simple to complex and from factual to conceptual. We prefer Bloom's taxonomy as a guiding model for designing UOLs because it defines cognitive outcomes of instruction in ways that we have found teachers can usually relate to. However, we anticipate that future development of a robust authoring system based on the LearningMapR process would allow users to substitute their own selected theoretical models for Bloom's Taxonomy.

Table 1: Categories for cognitive outcomes based on Bloom's Revised Taxonomy (EET, 2005) [4]. [Categories are used to define what the instructor wants the learner to Know and Do with respect to the Topic being learned.]

Know & Do			
1	Remembering	<input type="radio"/> Recognizing	- Locating knowledge in memory that is consistent with presented material
		<input type="radio"/> Recalling	- Retrieving relevant knowledge from long-term memory
2	Understanding	<input type="radio"/> Interpreting	- Changing from one form of representation to another
		<input type="radio"/> Exemplifying	- Finding a specific example or illustration of a concept or principle
		<input type="radio"/> Classifying	- Determining that something belongs to a category (e.g., concept or principle)
		<input type="radio"/> Summarizing	- Drawing a logical conclusion from presented information
		<input type="radio"/> Inferring	- Abstracting a general theme or major point
		<input type="radio"/> Comparing	- Detecting correspondences between two ideas, objects, or events
		<input type="radio"/> Explaining	- Constructing a cause-and-effect model of a system.
3	Applying	<input type="radio"/> Executing	- Applying knowledge (often procedural) to a routine task.
		<input type="radio"/> Implementing	- Applying knowledge (often procedural) to a non-routine task.
4	Analyzing	<input type="radio"/> Differentiating	- Distinguishing relevant from irrelevant parts or important from unimportant parts.
		<input type="radio"/> Organizing	- Determining how elements fit or function within a structure
		<input type="radio"/> Attributing	- Determining the point of view, bias, values, or intent underlying presented material.
5	Evaluating	<input type="radio"/> Checking	- Detecting inconsistencies or fallacies within a process or product.
		<input type="radio"/> Critiquing	- Detecting the appropriateness of a procedure for a given task or problem
6	Creating	<input type="radio"/> Generating	- Coming up with alternatives or hypotheses based on criteria.
		<input type="radio"/> Planning	- Devising a procedure for accomplishing some task. Producing

The second component of the LearningMapR will help instructors identify the Instructional Challenges for a given Topic and their Occurrence Patterns in terms of the proportion of students involved. We have developed a simple rubric for use in estimating occurrence patterns, as follows: *None*, *Mild* [affecting up to 5% of the class], *Moderate* [affecting 5-30% of the class], or *Extreme* [affecting 30-100% of the class]. Teachers are guided to content development strategies and student learning tasks aimed at addressing specific Instructional Challenge variables, or factors. Instructional Challenges may be comprised of a combination of factors occurring within the context of a course population. Instructional

Challenges that have been cited at our institutions include students' struggle with large volumes of information, lack of student motivation to engage with particular topics, students coming to class unprepared, misconceptions or difficulty understanding certain topics, or wide variations in prerequisite knowledge within a class. To define this aspect of the Topic requirements, the teacher selects Instructional Challenge variables from a list provided within the LearningMapR and rates each selection according to its Occurrence Pattern in their class. The results of this selection process and the identification of cognitive objectives from the *Know and Do* table comprise the data used by the LearningMapR to identify recommended Task, Teamwork, Tutoring and Content Development strategies.

Table 2: Instructional Challenge categories

Instructional challenge variables	Student Difficulty Instructional challenge occurrence patterns			
	None 0 %	Mild 0- 5%	Moderate 5%- 30%	Extreme 30-100%
Students do not prepare for class time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Difficulty in motivating student to engage with this topic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Students struggle with large volumes of information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Diversity of the student population in the class –not all students start from a common foundation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lab time is wasted teaching basic information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
No time to cover topics in depth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Difficulty providing feedback to individual students in large classes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Difficult concept to teach/learn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
No time for discussion in class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

At this point it is worth noting that, while the pedagogical activities and learning outcomes may be readily captured with current versions of the IMS specifications, it may be that the Metadata requirements related to Instructional Challenges will lead to a need for extensions to the specifications.

4 Steps of the LearningMapR Design Process

This section describes the steps that an instructor will go through in using the LearningMapR tool. There are six steps, some having sub-steps, which are generally

sequential in the course design process. However, they can and often will be taken in an iterative manner such that, for example, a UOL [or module] at some point within a course might be designed in detail first, without the rest of the course being considered until later.

4.1 Step 1: Define Outcomes and Assessment Methods for Course

Enter course outcomes [5] and methods of assessment. The course outcomes defined at this point should be quite general and tentative. Once you have defined the learning outcomes for each UOL in Step 2 the course outcomes and assessment methods can be specified more clearly.

4.2 Step 2: Define Outcomes and Assessment Methods for UOLs

Enter learning outcomes [5] and methods of assessment for each UOL. The learning outcomes defined at this point should be quite general and tentative. It is expected that you will want to make some revisions to them after completing more detailed design steps, which follow next. Once you have defined what you want the learner to *Know* and *Do* and have defined the Instructional Challenge variables and their Occurrence Patterns for each of the Topics, the learning outcomes and evaluation methods can be specified more clearly.

Step 3: Define the Topics to be covered in each UOL

Enter the titles of the Topics that will be covered in this UOL. The Topics should include references to specific areas or aspects of content to be learned.

4.3 Step 4: Define what Learners should Know and Do

Define what you want the learner to *Know* and be able to *Do* in relation to each Topic within the UOL. These are cognitive objectives, as identified by Bloom [4]. Using the *Know and Do* table, select from the 19 categories the one [or more] that best fits your objectives for this Topic. [6]

4.4 Step 5: Define Instructional Challenges and their Occurrence Patterns

For each Topic within the UOL define what instructional challenges you are facing. Using the Instructional Challenges table, select any/all Instructional Challenge variables that apply to your teaching situation. Then, select the Instructional Challenge Occurrence Patterns [in terms of percentage of the class involved] for each variable selected. [7]

4.5 Step 6: Review Task, Tutoring & Teamwork Strategy

Once values are selected for the Know and Do and the Instructional Challenges tables, previously successful strategies for Task, Tutoring and Teamwork will be ranked and displayed for this Topic. [See Appendix A for examples]. You will then be able to select from a repository that contains IMS-LD Task templates and exemplars to be re-used and

customised as necessary or desired. [8]. Each Task may include Tutoring and Teamwork components within it. The information you have provided will be matched with the recommendations accompanying the resources in the repository - these have been provided by the educators who created, used or evaluated the resources.

4.6 Step 7: Review Content Development Strategy

The Topic's strategy for content development will be identified by the LearningMapR, based on the cognitive [*Know* and *Do*] outcomes and the Instructional Challenges and Occurrence Patterns selected in Steps 4 and 5. The strategy suggests previously successful content planning steps related to the relative amount of time to be spent on content delivery vs. coaching. It also provides suggestions on the preferred complexity and quantity of content for the Topic. [9]

4.7 Step 8: Analyze Pedagogical Features of the UOLs and the Course

At any point in the LearningMapR, the instructor can review the following aspects of work in progress:

- A course map that displays pedagogical components that have been defined;
- Instructional Challenges that have been identified;
- The relative proportion of instructor time devoted to content delivery vs. coaching that has been estimated for each Topic within a UOL [these flow from the defined Content Strategies];
- Course-level and UOL-level learning objectives that may not yet be matched to instructional components [e.g., Tasks or Content Development Strategies]; and
- Underdeveloped sections of the course.

4.8 Step 9: IMS-LD Compliant Output

In the short term, courses developed using the LearningMapR will be exportable in three formats: a local application file format (for re-editing purposes), as IMS-LD Content Packages, and as printable visual storyboards. The storyboards will represent a map view of the course.

The LearningMapR IMS-LD database will house UOLs catalogued with both the *Know* and *Do* categories and Instructional Challenge variables so they can be searched and imported into the instructor's course. The instructor will be able to export the course as a whole UOL or sub-UOLs from within the course as individual content packages. IMS-LD compliant learning management systems will be able to load and run LearningMapR content packages directly.

5 Summary and Conclusions

Faculty time is a limited commodity. Focusing instructors' efforts toward the support of pedagogy rather than content can lead to a richer class time and advanced learning. In the transition to online instruction, instructors have typically focused their time on moving course content /Topics (e.g., PowerPoint slides, lecture notes, lengthy text materials, etc.) into the online environment and/or developing learning objects from scratch. Textbooks are a powerful kind of reusable content resource that need not be duplicated online. The LearningMapR helps to define how tasks can be developed, while the primary Topic [i.e., content] resource could be the textbook.

The LearningMapR will help the instructor decide what needs to be accomplished in class time and what needs to be accomplished in student time. It will provide Task, Tutoring and Teamwork templates and exemplars based on what instructors want the learner to know and do, while taking into consideration the Instructional Challenges that occur with the content. The storyboards that are created through the LearningMapR process will be exportable and printable.

To summarize, we see the LearningMapR as unique in its ability to serve as a useful tool for faculty. By addressing the challenges in the course design process starting from the instructor's point of view and using language that instructors typically use in describing teaching and learning, the LearningMapR adds value. It does so through the following approaches:

- Displaying a map of the pedagogical components of a course of study;
- Identifying previously successful pedagogical strategies involving learning tasks and content resources to address specific instructional challenges;
- Scaffolding the process of instructors re-thinking the ways in which they use class time; and
- Using the textbook as a major resource in support of the learning tasks.

In the future, the instructor will be able to search learning object repositories from within the LearningMapR tool, so that the Content development strategy provided is actually integrated with their search for content resources. At the present time, the tool is limited to making content planning suggestions including guidance on the types of content resources to search for to augment the textbook. Links will take users to learning object repositories, but once there, they must use the search mechanisms that are currently available.

In order to achieve a course-level UOL comprised of UOLs from the local repository, we will need to aggregate multiple UOLs into a single content package. While it is clearly stated within the specification that this is possible at design time, [11] we expect there may be issues in certain combinations of these UOLs at run time due to variations in role

assignment. Since we will be authoring the set of Templates and Exemplars for this project, we will be monitoring them to ensure that the various combinations work together at run time, and documenting any issues that arise.

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7 Footnotes

- [1] See details at <http://waterbuck.conted.ox.ac.uk/cgi-bin/trac.cgi>.
- [2] Specifications are available in full at <http://www.imsglobal.org/>. See also: Anderson & Wu (2004), Tattersall, Manderveld, Hummel, Sloep, Koper & deVries (2003) and Koper & Olivier (2004).

[3] The ELIXR project at California State University is an example of this direction.

[4] For a brief description of Bloom's Revised Taxonomy, see <http://coe.sdsu.edu/eet/Articles/bloomrev/index.htm>

[5] Outcomes may be implemented using the IMS Reusable Definition of Competency or Educational Objective specification (RDCEO, V 1.0).

[6] In future, full-function versions of the LearningMapR tool the following note will apply: *LearningMapR defaults to Bloom's taxonomy for specifying "Know and Do" outcomes using the cognitive values of Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating. If users prefer other taxonomies or models that their institution has adopted, these can be used in place of Bloom's.*

[7] In future, full-function versions of the LearningMapR tool the following note will apply: *LearningMapR defaults to its own definitions of Instructional Challenge Occurrence Patterns, including None [none of the students in the class], Mild [up to 5% of the students], Moderate [5-30% of the students], and Extreme [30-100% of the students]. The instructor is also able to identify specific Instructional Challenge variables for each Topic. If users prefer other levels that their institution has adapted then they can be used in place of the default rubric.*

[8] In future, full-function versions of the LearningMapR tool, the instructor will also be able to select from national and international IMS-LD compliant, peer reviewed learning design repositories.

[9] In future, full-function versions of the LearningMapR tool, the instructor will also be able to select from national and international IMS-LD compliant, peer reviewed learning design repositories.

[10] <http://dspace.learningnetworks.org/retrieve/206/IMS+Learning+Design+FAQ+1.0.pdf>

[11] A UOL can contain resources, **and indeed other UOLs, either directly in the content package** or by referencing using URIs. The use of referencing rather than direct inclusion in a content package makes it possible to deliver UOLs while referenced sub-components are still under development - a link is created in a UOL to a location in which another resource will be placed when completed. The UOL can be frozen, since it will not be modified, and runs can be spawned to reach the market before production has completely finished.

8 Appendix A: LearningMapR Steps: Explanation and Examples

Step 6. Review Task, Tutoring and Teamwork Strategy

Step 7. Review Content Development Strategy

It is in these two steps of the LearningMapR process where the pedagogical and content development to support learning of a Topic comes together. This is the point at which the instructor is guided through Task, Tutoring, Teamwork and Content Development recommendations, based on what they want the learner to know and do, and difficulty estimate for the Topic. The difficulty estimate may be further qualified through selecting of one or more of the Instructional Challenge variables listed. The instructor is then presented with Task and Content Development template(s).

Example 1: The instructor has decided that, for a particular topic, she wants the learner to recall specific information (*Know and Do, Remembering/Recalling*) and for the instructional challenge, indicates *there is no time to cover this topic in depth* and that the occurrence pattern is *Mild*.

- Step 6: The LearningMapR would recommend a Remembering/Recalling type task and provide at least one Remembering/Recalling Task template. The task templates might include quizzes on text material to be learned, or a series of One Minute Summaries, which allow students to recall in their own words the material just studied. The instructor would be able to choose from a number of suggested tasks to view and or import into her online course.
- Step 7: Because this Topic focuses on recalling facts and has a *Mild* level of difficulty involving limited class time to cover the Topic, The LearningMapR might recommend that the main source of content to support this topic be the textbook, and that delivery of the content be moved out of class time to independent student study time.

Incorporating a task in the time spent on this Topic will help both the learner and the instructor monitor understanding of the material and either access or provide appropriate feedback. The task helps to motivate the learner to make an attempt at understanding the material. It also allows the instructor to monitor students' level of understanding and to design appropriate feedback.

Example 2: For another Topic the instructor has decided that he wants the learner to be able to detect inconsistencies or fallacies in arguments and position statements presented (*Know and Do, Evaluating*). He has indicated that this is a *difficult concept to teach/learn* [reflecting the type of instructional challenge he faces], and that the occurrence pattern is *Extreme*.

- Step 6: The LearningMapR would suggest a set of Evaluating Tasks from which the instructor could select one.

- Step 7: Since the instructor has ranked this Topic with a difficulty level of *Extreme*, related specifically to the difficulty of teaching and learning this material, it will be important to provide content and task resources that will scaffold students' understanding of the material. The LearningMapR might recommend, for content strategy, linking to additional learning objects, illustrated lectures, and specific parts of the textbook to focus on in more depth. In terms of learning tasks to support student understanding, the LearningMapR would likely provide templates and exemplars to help the instructor set up and run small group discussion or debates.