CompendiumLD: a tool for creating shareable models of learning designs

A Final Report of the OULDI-JISC Project

Andrew Brasher

1   Introduction

CompendiumLD is a software tool for designing learning activities using a flexible visual interface. It is intended to help lecturers and others involved in education to articulate their ideas for designs and can be used to produce visualisations and models of learning designs at the activity, unit and module levels. CompendiumLD comes with predefined sets of icons, some generic and some specific to learning design. These icons may be dragged and dropped, then connected to form a map which represents the interactions between tools, people, resources, outcomes and so on within a learning activity. CompendiumLD is a specialised version of Compendium, a tool for knowledge mapping, i.e. managing connections between information and ideas that has been applied in many domains including the mapping of discussions and arguments (Shum & Okada, 2008). As most of the core knowledge mapping facilities provided by Compendium are included within CompendiumLD, it can be used for learning design, and applied to other information mapping and modelling problems.

Development work started on CompendiumLD in summer 2007 funded by the Open University, and has continued since then with the support of the Open University and JISC. In parallel with the development of the software itself, a variety of resources to support use of the software and visual modelling of learning in general have also been developed. This report describes work towards building the functionality of CompendiumLD itself and the supporting resources (e.g. the CompendiumLD web site, videos, and visual modelling post-it packs) during the Open University Learning Design Initiative (section 2)(JISC/Open University, 2009).   It illustrates how that functionality has been informed by developmental testing, presents some quantitative and qualitative data about usage of CompendiumLD (section 3) and concludes with a description of challenges and recommendations for future work (section 4).

To put this report in context, objectives and outputs from the OULDI project plan which are relevant to CompendiumLD are stated below.
Objectives (JISC/Open University, 2009)
4. To pilot learning design methodologies, tools and techniques in at least eight trials and to document and evaluate this experience
8. To undertake and review annually enhancements to the visualisation software used to support the pilot and design mapping tasks (e.g. CompendiumLD)
9. To continue to broaden in scope, content and definition the OU learning design methodology. This currently includes, although is not limited to:
    - Use of visualisation to support creative process of course and activity composition and assembly; orchestrate learning sequences thereby supporting the planning of writing, author reflection, critical review; as artefacts for establishing shared understandings and negotiating conceptions and to facilitate communication between stakeholders and established shared languages.

Project outputs
d. A set of resources and guidance on different aspects of learning design and outlines for associated design activities and tailored workshops.
f. Evidence of use of a software application designed to support learning design and visualisation.

2   Learning design functionality and resources

2.1   Introduction

This chapter describes the learning design functionality that has been developed over the course of the project, and outlines the rationale for decisions made during the development process. It describes the functionality implemented in terms of functionality for design, functionality for saving and sharing design information, functionality and resources for helping designers,. It includes a brief summary of the installers developed for different platforms, and it concludes with a brief overview of a set of resources intended to support users make the transition to designing visually.

Our starting point was that learning design is inherently creative and iterative (Conole, Brasher et al., 2008; Conole, Cross et al., 2008). Beetham notes 'good' design does not always move in a linear fashion from theory to principle to practice (Beetham, 2007, p. 37). We wanted to avoid developing a restricted tool which may constrain users in their design process. We wanted the tool to facilitate and guide design, whilst still ensuring freedom and encouraging creativity for its users.

Development has focused on modifying the source code of the Compendium mapping tool developed by the Knowledge Media Institute (KMI) of the Open University. In parallel with the development of the software itself, a variety of resources to support use of the software and visual modelling of learning in general have also been developed. These resources (e.g. the CompendiumLD web site, videos, and visual modelling post-it packs) are also described in this report.

The changes made to CompendiumLD during the project have been informed by a variety of developmental testing actions including observations at workshops, a survey, expert evaluation and a semi-scripted evaluation (see section **Error! Reference source not found.** for more details).

The latest version of CompendiumLD (currently version 1.2) can be downloaded from the CompendiumLD web site.

2.2   Rationale for selection of Compendium as the basis for CompendiumLD

Compendium is a form of mind mapping or argumentation software that provides a default set of icons for creating interactive maps to describe argumentation, and for communicating issues within discussions amongst interested parties (see e.g. Buckingham Shum & Okada, 2008). Users drag and drop icons onto Compendium's user interface so creating nodes which may be linked and labelled. The three classes of node objects within Compendium that are of interest with respect to learning design are
•   NodeSummary - this holds the information about the node, including its label, image, and descriptive textual information added by a user
•   Link node - this holds information about a link from a source node to a destination node.
•   View node - this is a subclass of NodeSummary i.e. it holds all the information that a NodeSummary does, but has additional attributes (e.g. positional information) which enable the Compendium application to create lists views or map views (Bachler, 2004).

The user interacts with CompendiumLD via its GUI whilst the application itself maintains a data model of the nodes which are displayed, created, and edited by the user. The underlying flexibility of the "node-link-node" data model means that functionality for a particular semantic interpretation of the meaning of a node and the meaning of a link can be added without having to restrict the flexibility of the application as a whole.

Comepndium was selected as the basis for our tool as it is a sophisticated tool with significant functionality, which could be relatively easily adapted and modified for our purposes. The inherent philosophy underpinning Compendium, in terms of providing visual representation to support the development of thinking and shared argumentation also fitted our criteria for selection, as it aligned well with our requirement to develop a tool which developed user thinking specifically for the design process (Brasher et al., 2008).

2.3   CompendiumLD's design functionality

Most of the modifications have been additional Java classes and sub-classes which realise our desired semantic interpretation of nodes to represent learning activities, roles, tasks etc. and links to link learning tasks to roles etc. In this context, our understanding of 'learning activity' concurs with Beetham's definition: "a specific interaction of learner(s) with other(s) using specific tools and resources, orientated towards specific outcomes" (Beetham, 2007). CompendiumLD provides some specific learning design related functionality in addition to the functionality provided by the Compendium 1.5.2 /2.0 beta code bases.

The changes made to Compendium to create CompendiumLD fall in to six categories:

1. Introduction of learning design functionality
    a. The OULDI has developed 5 Compendium stencils to support design of learning activities.
    b. Functionality to add information about expected time to be spent by students and tutors on learning activities has been introduced.
    c. Functionality for importing, exporting and sharing learning designs has been introduced and extended during the project
    d. Context sensitive help has been introduced
2. Introduction of functionality originating from Compendium 2.0 code base
3. Other general purpose functionality added
4. Functionality removed
5. Documentation included or linked to from CompendiumLD
6. Installers for different platforms.

These are described in more detail is the remainder of section 2.

2.3.1   Learning design stencils

Four learning design stencils have been created by the OULDI team.

- Core learning design stencil
  This contains the **core learning** design nodes for modeling learning activities.
- Sequence mapping stencil
  This contains nodes to identify zones of the working area as swim-lanes, and a template for laying out an activity according to a swim-lane framework.
- Conditional stencil
  The Conditional stencil is a means of including different learning pathways within a design.

- Outcomes, activities and concepts stencil
  This contains nodes to prompt the designer to relate learning outcomes to both learning activities and concepts to be learnt.

Two other stencils have recently been introduced via another project and are include in he appendices for completeness.

Core learning design stencil

The Core learning design stencil loads automatically with CompendiumLD. It consists of nodes that representing aspects of learning activities i.e. "a specific interaction of learner(s) with other(s) using specific tools and resources, orientated towards specific outcomes" (Beetham, 2007).

	Node name	Icon	Description
1	Activity		CompendiumLD's Activity node is based on Compendium's Map node. Double-clicking a map node opens it to reveal the map's contents. The contents can be any combination/layout of any of CompendiumLD's nodes and links, unless the Activity is a newly created node in which case it will be empty until other nodes and links are added. Learning design specific functions provided by Activity node's include a specific menu available via a mouse right-click and a display of timing information.
2	Learner Output		The Learner Output node is intended to represent material that a learner creates during a learning activity. When the user creates a Learner Output node they are prompted to choose the way it will be assessed from: 'formative', 'summative', or 'other'. The icon displayed depends on the choice made: summative , formative, or 'other': .
3	Learning Outcome		The Learning Outcome node is intended to represent a learning outcome, and be linked to a leaner's task or activity.
4	Resource		The Resource node can be used to represent a document, video or website that the learner utilises during a learning activity. It is intended to represent resources which do not yet exist, but which the designer plans to implement. If a resource does already exist at the time the activity is being designed (e.g. a draft Word file or Image) it may be dragged and dropped onto the Activity instead of using this Resource node. These existing resources will be represented on the Activity map by a standard icon e.g. for Word files, for PDF files, or for web sites.
5	Role		The Role node is used to represent actors (e.g. students and tutors) who play specific roles in the Activity being designed. When the users create a Role node they are prompted to choose from: 'Student', 'Tutor' or 'Other'. The 'Other' role may be used to model practice based support roles for example.

	Node name	Icon	Description
6	Stop		The Stop node is used to represent the point the activity finishes for a particular role player. For students, all the learning outcomes linked to the activity should have been addressed by the time the student reaches this node.
7	Task		The Task node is used to represent an action performed by an actor (usually either a student or a tutor).
8	Tool		The Tool node is used to represent a tool in a learning activity. Tools are utilities which actors use to create outputs or to interact. When the user creates a Tool node the are prompted to choose one of 'Blog', 'E-portfolio', 'Forum', 'Instant messaging', 'Podcast', 'Simulation', 'Virtual World', 'Wiki' or 'Other'. Typically a tool node will be used to link a Task performed by one actor (e.g. a student) with another Task performed by a different actor (another student or a tutor), and/or with an Output node. There is also a help option on the menu presented to enable the user to a select the tool type. Selecting this opens a web search of selected sites known to contain information about tools and learning design, see e.g. this example search for 'wiki'.

Sequence mapping stencil

The sequence mapping stencil is used for laying out designs using 'swim-lanes'. An example of use of the stencil captured during the design process is shown in **Figure 1**. The stencil comprises icons used for the heading of each of the 'swim-lanes' in the sequence map, a template containing a pre-arranged layout of these swim-lane headers, and a 'clock' icon for showing time.

Node name	Icon	Description
Sequence map		This creates an activity map containing the nodes below already laid out to get the designer started quickly.
Date/Time schedule marker		This is used to indicate a particular time and/or date during a learning activity e.g. 'week 3' or '2nd hour''.
Intent and challenges		A design should look to capture or express what the designer is aiming to achieve pedagogically when creating a design and what they consider to be the important challenges to learning presented by objects or associations between objects elsewhere in the design (for example, the common challenges experienced around teaching magnetism, or the common problems of wikis). During design, populating this column should help the designer better understand the key pedagogic design problems; after design it may help them determine the closeness of fit between their initial intent and actual solution.

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Learning output		The output may be anything from a written assignment to a subtle observation of behaviour. The outputs of learning, may be for student's future use, for summative or formative assessment, for research, for evaluation (can better use be made of outputs by students or teachers), for workload planning, or for quality/teaching assurance purposes. It is only from the outputs of learning activity that a teacher will know if learning outcomes (an aspect of what is to be learnt) have been met.
What is to be learnt		A design should clearly show what the designer is anticipating the student will learn. There is widespread consensus that learning outcomes, or objectives, are central to any design. Although there are varying ways of classifying learning outcomes, they will commonly include knowledge and understanding, skills and attitudes and may be expressed as specific objectives appropriate to individual activities and/or broader outcomes of the unit of learning.
Student activity		A description of what the student is asked to do during the learning activity, or of what is thought that they actually will do.
Media and tools		The tools and media used to deliver resources to the students. See 'Student resources' below.
Student resources		A description of the semantics and meaning of material to be delivered to students (it is to be delivered via media and/or tools). Examples include a description of a theory, which could be delivered in a printed document, in a web page, via a simulation, or in a combination of these three media and tools.
Support roles		Support will likely include the teacher but can also include others involved in the learning such as work based mentors, student support services or, indeed, other learners.
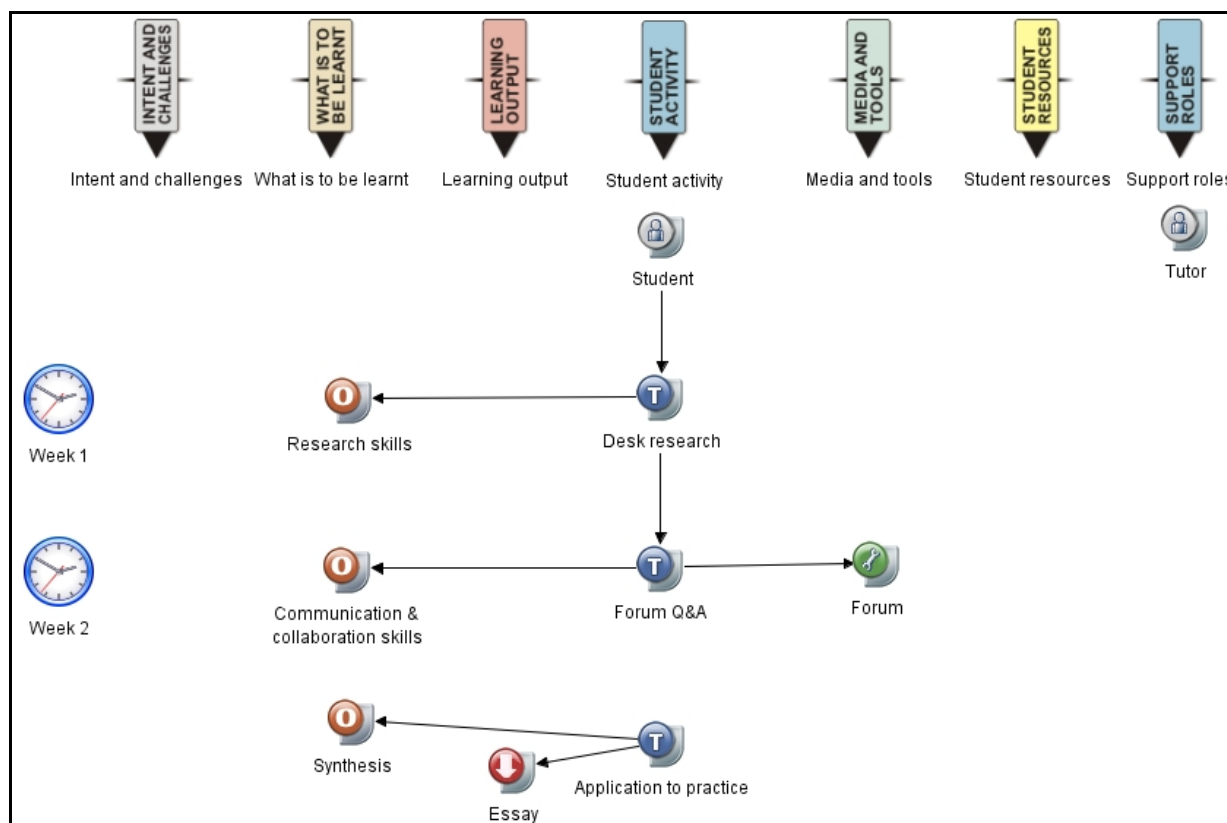
Figure 1   **An example of a design in progress illustrating use of the sequence mapping stencil**

Conditional stencil

The Conditional stencil is intended to express conditions of the type "if X then Y else Z" within a design, as a means of including different learning pathways within the design. There are three icons in this set (listed in alphabetical order):

Node name	Icon	Description
Condition		The Condition node is used to express a condition that affects a student's path through a learning activity. It can be used to show conditions that must be true or false, typically expressed as a question e.g. "Student passes formative test?" or "Student prompted to redraft essay?" Compendium's Question or Issue node ( ) has not been used to express a condition because a CompendiumLD condition needs a precise answer, either true or false, whereas a Compendium Question can have many alternative answers. The design of the Condition node has been made similar to that of the Question node to reflect that a Condition may be regarded as a special case of a Question.
True		The true node is used to show the path that is followed if the condition is true.
False		The false node is used to show the path that is followed if the condition is true.

Outcomes, activities and concepts stencil

This stencil is for examining relationships between the concepts to be taught, the learning outcomes that relate to the concepts, and the activities to teach the concepts.

It enables the designer to create two different types of map, one showing the relationship between concepts and learning outcomes, the other showing the relationship between learning activities and leaning outcomes. The concepts to be taught and learnt should relate to a learning outcome, and each learning outcome should relate to at least one activity.

Node name	Icon	Description
Concept		Used for a concept to be learnt.
Map learning outcomes to activities		A map in which learning activities are linked to leaning outcomes.
Map learning outcomes to concepts		A map in which concepts are linked to learning outcomes.
Learning outcome		A learning outcome.

This stencil allows the designer to approach a design problem from two different angles, the common feature linking the approaches being the need to define learning outcomes.   In the first angle of approach, the designer creates a map relating learning outcomes to activities. In this approach the designer needs to either describe learning outcomes first, then give a brief description of activities that will lead to one or more of the outcomes, or to start with an idea for an activity and then to envision the outcomes. Either way, the result will be a map relating learning outcomes to student activity as shown in Figure 2. In this example, the designer is planning two different activities each of which lead to four common outcomes, though the fifth outcome differs.
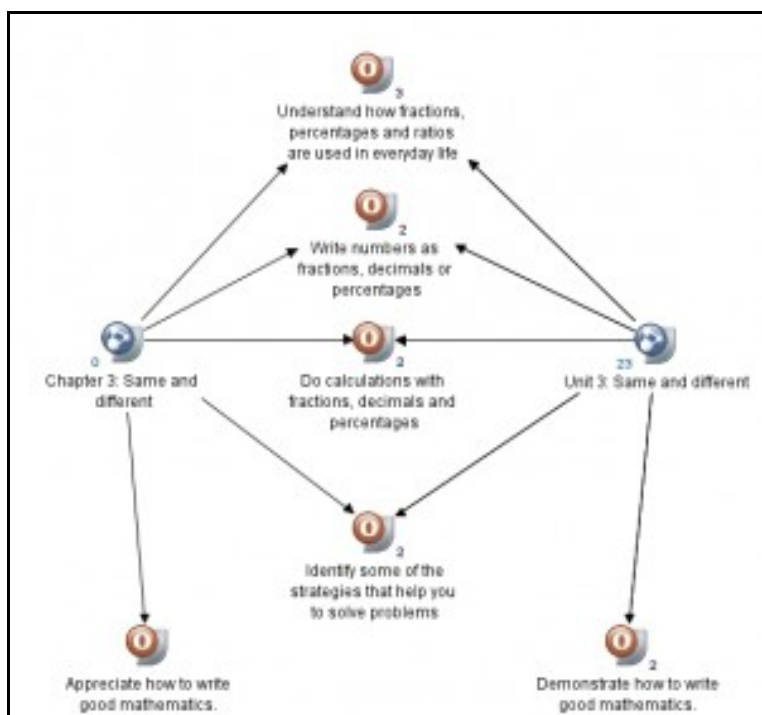
Figure 2 Example of a learning outcomes to activities map

In the second approach the designers maps relationships between concepts that the student is expected to have mastered at the end of the course, and learning outcomes which demonstrate that mastery. An example of such a map is shown in Figure 3.
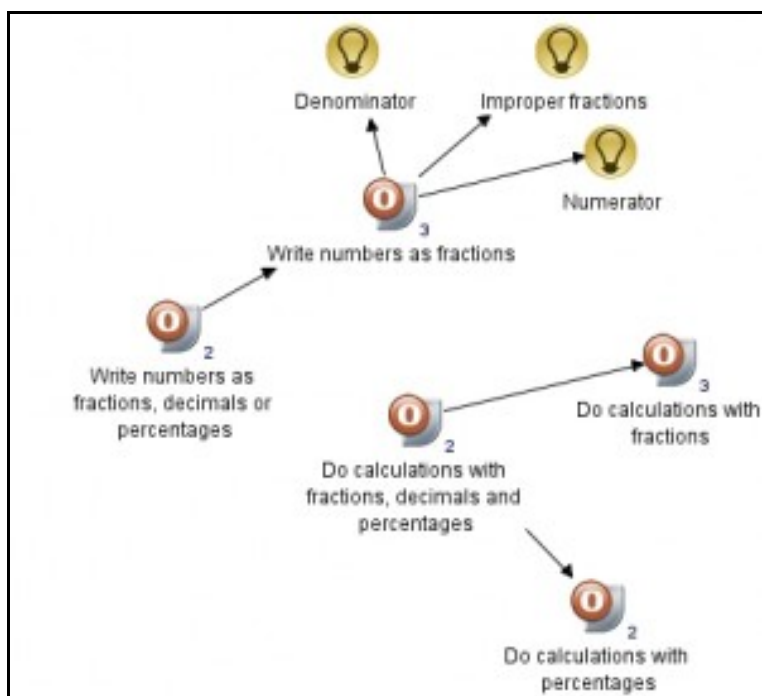
Figure 3 A map showing relationships between some concepts that the course is intended to teach students, with the learning outcomes that are presented to students

2.3.2 Activity timing information

The timing functionality can be seen in use in Figure 4. CompendiumLD allows the user to specify how long they envisage a task will take for a particular role-player (e.g. student or tutor) to complete. CompendiumLD keeps running totals of the time for all tasks assigned to each role player, and these times and totals
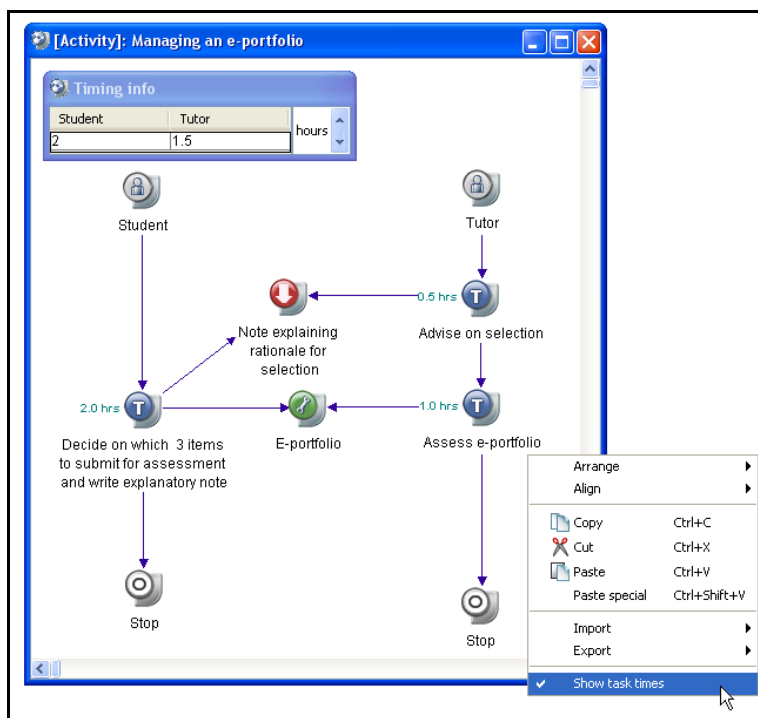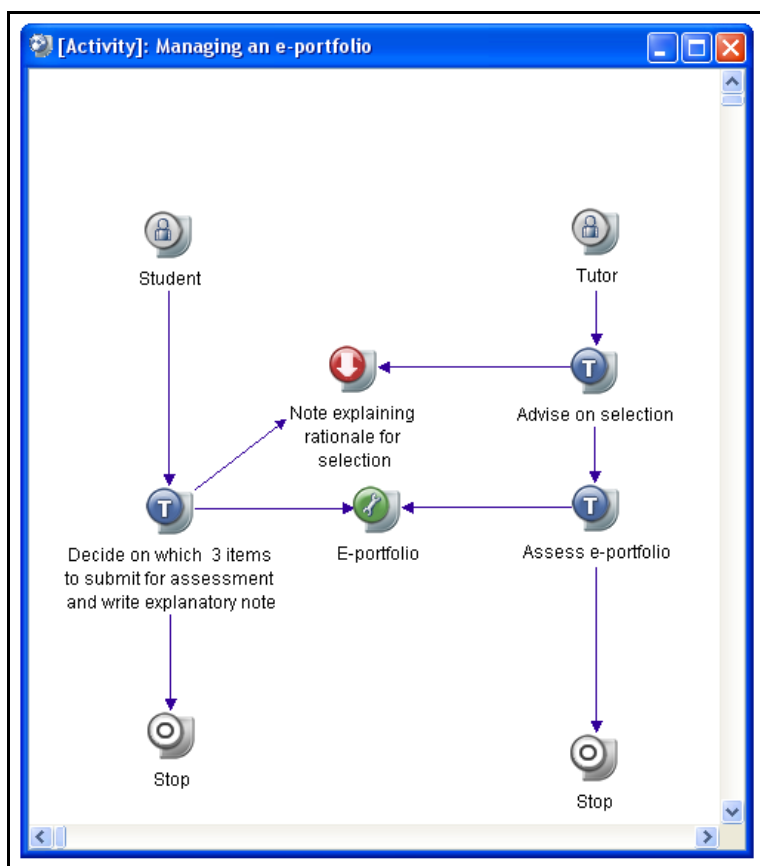
Figure 4 Top screenshot showing an activity design with the popup menu to show or hide the task timing information. Bottom: the same activity with the timing information hidden from view

can be displayed or hidden. This show/hide functionality enables the user to show or hide the activity timing information as appropriate to the design problem in hand. Its use is illustrated in figure 2.

In the current version of CompendiumLD, the total time for task sequences does not included times for tasks which occur after a Condition node.
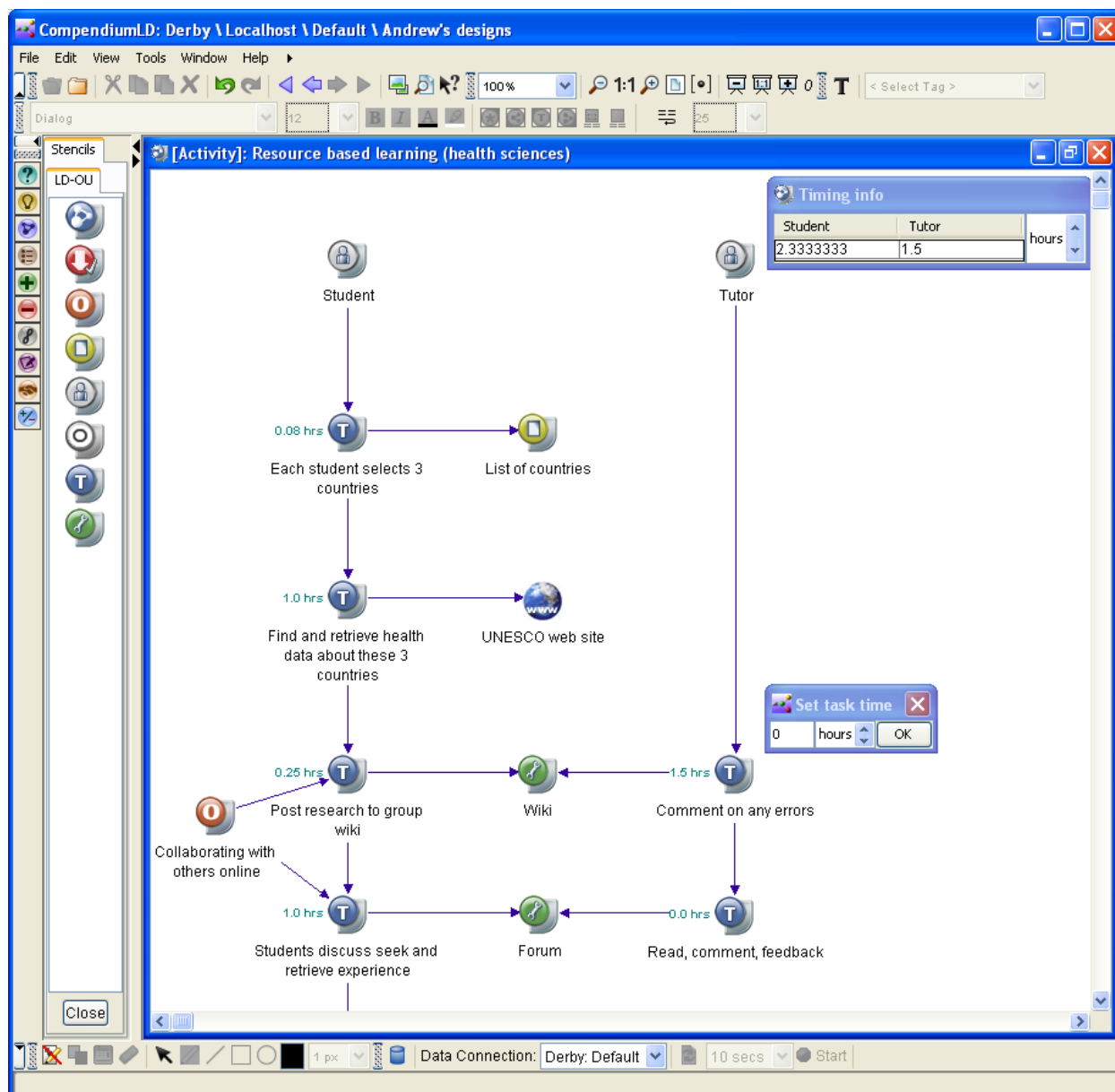
Figure 5 Screenshot of CompendiumLD showing a design in progress.

2.3.3   Summary of functionality originating from Compendium 2.0 alpha code base

Two features from the Compendium 2.0 beta code base have been included in CompendiumLD. The first is the functionality which hides some of the less frequently used menus and menu options from the user as illustrated in figure 6. This has been included with the aim of enhancing the usability of CompendiumLD.
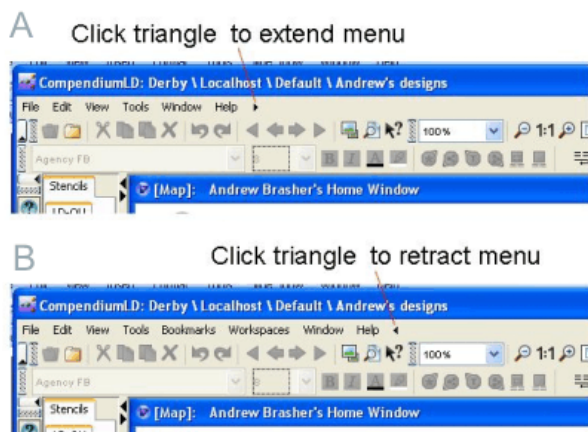
Figure 6 Screenshot showing two views of the main menu: (a) the default setting with the 'Workspaces ' and 'Bookmarks' options hidden, and (b) the extended menu with these two options available

The second is a partial implementation of the externalization of strings. 'Externalization of strings' means moving text that is used in the application's user interface out of the code and into external text files. This means that any user may edit these files for their own installation and hence change the text used in menus and other components of CompendiumLD's user interface. In addition, if versions of the files in different languages are generated, CompendiumLD's interface will be available in all languages for which there are corresponding files. Storing the user interface text in external files will facilitate both internationalization of the application, and the creation of institutional specific versions.

The work carried out to date towards externalization of strings has been to integrate the language file reading code from the Compendium 2.0 alpha code base into CompendiumLD, i.e. CompendiumLD now has the capability to read text from external files and use this text in its user interface. In addition a fraction (about 15%) of approximately 2000 text strings used in CompendiumLD's interface have been externalized in English so far, including all those for the menus.

2.3.4   Other general purpose functionality added

Changes have been made to the way CompendiumLD draws links between nodes. In the standard version of Compendium the link start or end point is a point on the rectangle which contains all components of the node on the user interface. The node components are its icon, its text and the property indicators such as detail, tag, items and transclusion indicators. Figure 6(a) shows how a link is drawn between two nodes, each having an icon, a text label and a detail indicator (I). The link is drawn between the rectangles which contain all the node components shown as a red dot-dash line in figure 6 (a).

In CompendiumLD, the link start or stop point is formed from the boundary of each component forming the node's user interface, as shown by the red dot-dash line in figure 6 (b). In CompendiumLD, the link direction is such that if extended it will pass through the centre point of the icon rectangle, whereas in Compendium the link will pass through the centre point of the rectangle bounding the icon rectangle, text rectangle and other indicators, i.e. the centre of the red dot-dash rectangle in figure 6 (a).
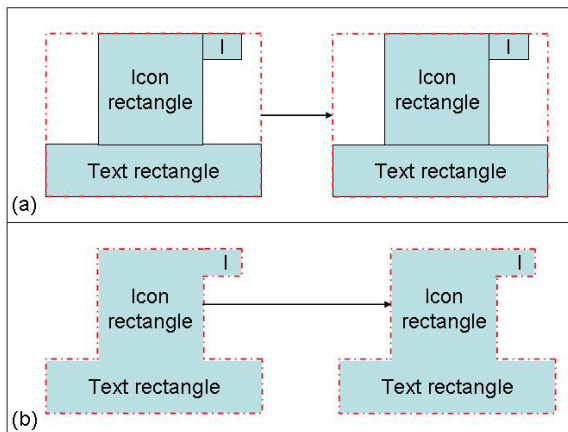
Figure 7. Link bounding shape for Compendium standard (a), and for CompendiumLD (b)

Figure 7 shows the difference this change to the link drawing algorithm makes for a link between two of Compendium's standard nodes.
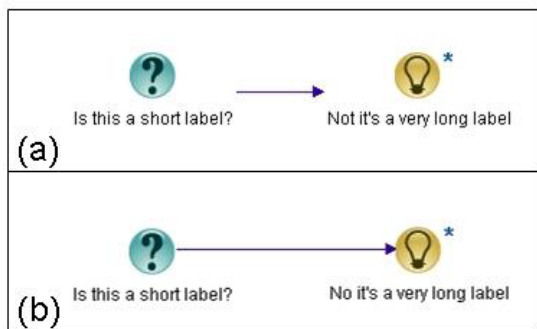
Figure 8. Examples of links between nodes for Compendium standard (a), and for CompendiumLD (b)

2.3.5   Functionality removed

The only functionality removed has been Compendium's 'Inbox'. This has been removed from CompendiumLD because it was thought to be unlikely to be used by learning designers, and removing it frees up space for design on CompendiumLD's user interface.

2.4   Saving and sharing learning design data

Compendium provides many different options for saving map data, and these were all included in early versions of CompendiumLD as the only ways of saving and sharing learning design data. During the OULDI project it became clear that these options are not easy for novice CompendiumLD users to use, and that in many usage scenarios they restrict the utility of the design products that CompendiumLD could produce (Brasher, 2010). To counter this, over the course of the project we have created two additional export options to simplify and enhance the saving and sharing of design data. These are included in the latest version of CompendiumLD along with all the other options that Compendium provides (so as to not restrict the flexibility of the tool).

The usability and utility issues stem from the fact that although Compendium provides many different options for exporting data , the interface to select options for saving map data is complex, and the products that can be produced are of limited use to the target user group, i.e. academics and other staff involved in teaching. The forms that Compendium can export data to include Jpeg image files, HTML renderings of nested maps[1], and XML encoding of nested maps. The simplest output form is the Jpeg image, but this form does not reproduce any of the interactive features that Compendium provides, e.g. the ability to nest maps or read text notes stored within nodes, thus limiting its usefulness. The HTML export (referred to as 'Web maps' in the Compendium UI) can be used to share an interactive version of a Compendium map that may be viewed in any browser, but does not permit the map data to be edited. Also, the export is structured as a set of web pages in nested folders, so sharing an interactive web map requires the folder structure to be copied to a shared space, or to be zipped and e-mailed, both actions require an overhead in effort and knowledge. The XML option also allows users to save multilevel nested map data, and the maps encoded in the data can be edited in Compendium using its GUI. However the XML file format is proprietary and can not be viewed in common desktop or web applications.   Both the XML export and web maps (HTML) options require the user to make several decisions before an export can be completed. These include the depth of nested maps to be exported, and whether to include resource files such as Word documents that are linked to within the map in the exported data .

To counter these issues we designed a simpler way to share learning design data files with other CompendiumLD , and this was released in CompendiumLD version 1.0 during May 2010 (section 2.4.1). Towards the end of the project we have worked on a way of sharing design data that enables people without CompendiumLD to view complex nested interactive maps by using the SVG format. The work done yields interactive maps that may be viewed in any recent browser, and offers a way to include editable map data (section 2.4.2).

2.4.1   Saving and sharing by file exchange

CompendiumLD version 1.0 and later has an export option entitled 'Learning design file' which allows the user to export a file containing their design without having to make any decisions, except to name the file that the design will be saved into. A learning design file created in this way is a zip file that includes the design data and any images and files used in the design uses so that it can be recreated (and viewed and edited) by another user using their installation of CompendiumLD.   This has been achieved using a corresponding import learning design file option.

Currently, a CompendiumLD learning design zip file or CompendiumLD xml file can not be imported into the standard version of Compendium. This is because CompendiumLD exports will usually contain data about learning activities (e.g. timing data, and whether or not to display this) which is not handled by the standard version of Compendium. However, a standard Compendium zip or XML file can be imported into CompendiumLD.

2.4.2   Saving and sharing in a browser friendly format

Learning designs may be exported In the SVG format (W3C SVG Working Group, 2011b), and shared via e-mail, or by uploading the SVG file to a web site.

Motivation

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[1] http://compendiumld.open.ac.uk/documentation/examples/middle-east-role-play/

The motivation for this is to improve the way that CompendiumLD maps can be shared, by

1. Reducing the effort required by users to share interactive maps
   Users can save an SVG file from CompendiumLD. By copying this single file to their own web site, or to a file sharing service such as Dropbox[2], or by e-mailing the file, an interactive version of nested designs and maps make be shared with other people. The only technical requirement to view and interact with the SVG is a recent browser.
2. Facilitating the embedding of maps in web pages
   The SVG files produced by CompendiumLD include a link which pops-up HTML code, which if copied and pasted into a web page, will embed the interactive SVG map in that page (see section 'SVG code structure for design maps' for an image showing the embed link).
3. Using a file format that other applications can work with
   SVG files may be edited by desktop applications such as CorelDraw or Adobe Illustrator, web applications such as SVG-Edit, and there are several code libraries for developing web applications which include facilities for SVG manipulation (see appendix 1).

SVG technology

The technology we have used is the W3C's Scalable Vector Graphics (SVG) format. SVG seemed an obvious place to start because it is a format designed for 2 dimensional graphics, and almost all browsers now display SVG content, and numerous other applications can open and edit SVG files (including some web based tools).
This quote from the W3C's site summaries some of the power that SVG offers
"SVG allows for three types of graphic objects: vector graphic shapes (e.g., paths consisting of straight lines and curves), images and text. Graphical objects can be grouped, styled, transformed and composited into previously rendered objects. ……..SVG drawings can be interactive and dynamic"[3].
SVG also supports supporting zooming, panning and scripting and other functionality that encouraged us explore it in relation to interactive maps of learning activities. This exploration has resulted in the definition of an SVG file structure for encoding learning design maps. As SVG is a very flexible format, images with the same visual appearance and interactivity may be achieved encoded using many different SVG elements and structures. Because of this, we have put some thought into the structure of SVG code that CompendiumLD produces, as this (we hope) will facilitate its extension and use as, for example, the basis for a browser based learning design editor.

SVG code structure for design maps

This structure is presented as a set of guidelines for encoding design maps in SVG. As the same visual appearance can be achieved using many variations in SVG coding, we have developed these guidelines with the aim of delivering high quality in the rendered image, coupled with a desire to split code specifying the semantics of the map content from code specifying the maps visual appearance and interactivity. Reasons for wanting to achieve this split of semantics from appearance include

- to facilitate the changes in node and link appearance, e.g. changes to node stencils and changes made interactively
- to make text in the maps searchable
- to provide a framework for development of a browser based editor.

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[2] http://www.dropbox.com
[3] http://www.w3.org/TR/SVG/intro.html#AboutSVG (W3C SVG Working Group, 2011b)

Note that these are guidelines, not a formal DTD or schema: CompendiumLD generates SVG content that both conforms to the W3C SVG DTD (W3C SVG Working Group, 2011a) and that follows our guidelines.

The structure of a SVG interactive image that CompendiumLD generates is composed of six components. Four of these components are generated by CompendiumLD when the user selects the SVG export option. These components represent the map data and are stored in the SVG file that CompendiumLD generates; three of these four components are panes which make up the window which the user interacts with, the other is a set of definitions of icons and other graphic elements. The remaining two components are referenced by the SVG file, but are stored externally, on the CompendiumLD website . One of these components contains the CSS styles that control the look of the SVG image, the other the Javascript code which implements the interactive behaviour of the image. The six components are:

1. **A series of definitions of graphic elements including the node icons** (*theses are contained within the SVG file*)
   Each icon is defined as a group <g> of SVG elements in the <defs> section at the beginning of the SVG file. Although the SVG specification allows icon definitions implemented in a <def> element to exist in an external file, only the Firefox and Opera browsers currently support this feature. For this reason we have included them in the main file, although it would be advantageous if they could be external.

2. **Code which specifies the contents of the maps in the "View Pane"** (*also contained within the SVG file*).
   This includes SVG code to specify where particular nodes should be positioned on the SVG canvas, the text and other adornments for each node, and inks between nodes. All the elements in this component are contained within an SVG group <g> element, which we call the ViewPane group (see Figure 9).

3. **Code which specifies the content of a navigation pane** (*also contained within the SVG file*).
   If the CompendiumLD design or map being exported contains sub-maps, it is a hierarchy of maps within maps. The navigation pane allows the user to navigate between the map levels (see Figure 9).

4. **Code which specifies the content of a help pane** (*also contained within the SVG file*).
   The help pane (see Figure 9) contains links to documentation about CompendiumLD, to embed code for the design or map, to download the map, and to show the map full screen

5. **Styling information for nodes and links** (*contained within a CSS file linked to from the SVG file*)
   The SVG file generated by CompendiumLD contains a link to an external CSS file located on the CompendiumLD web site. This CSS file contains definitions of styles for text and graphic elements that are included in the view pane, help pane and navigation pane.

6. **Scripts specifying interactivity** (*contained within a Javascript file linked to from the SVG file*)
   The SVG file generated by CompendiumLD contains a link to a Javascript file which implements the behaviour of the elements that are included in the view pane, help pane and navigation pane.
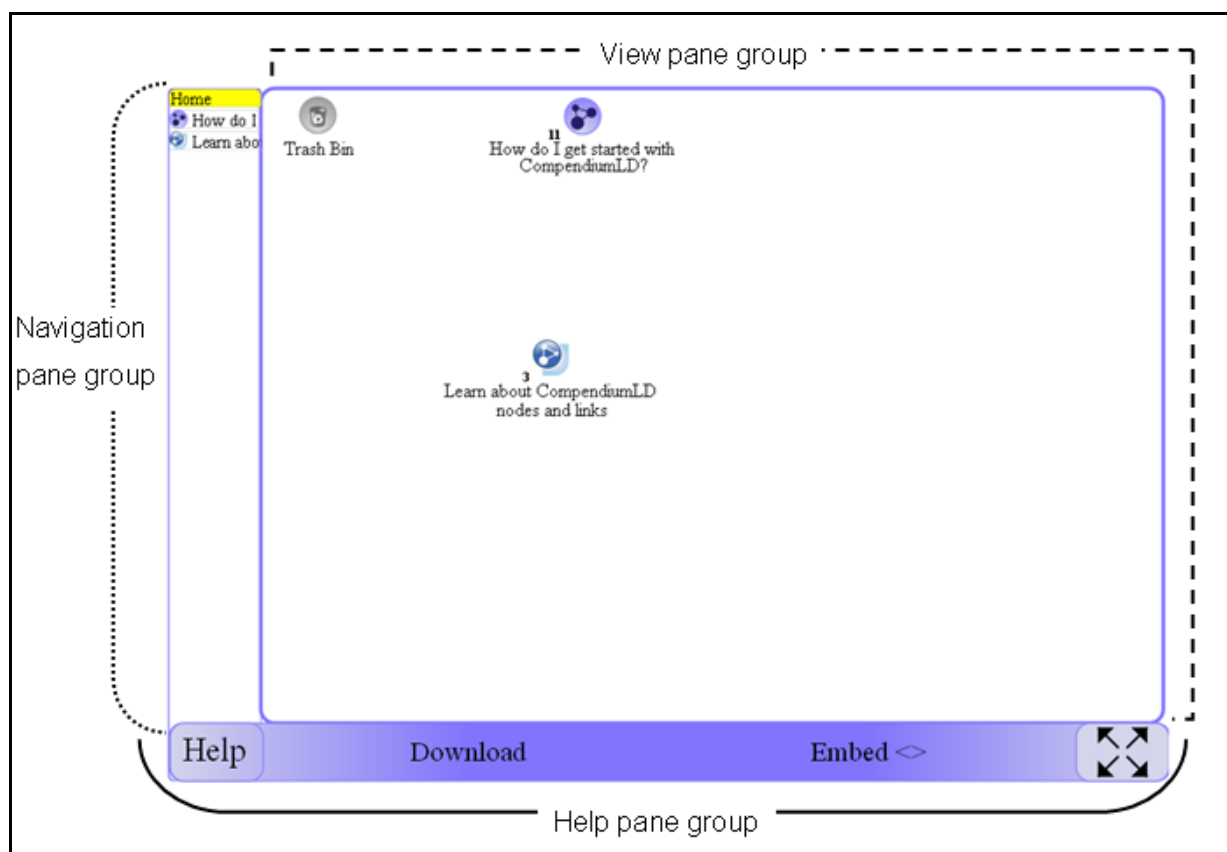
Figure 9 The structure of the panes within a CompendiumLD SVG interactive map window

Handling linked resources in CompendiumLD's SVG output

Resources such as Word documents, PDFs, and other file types may be included in CompendiumLD maps. Typically, the user drags and drops the file of interest from their file manager or finder window onto the CompendiumLD working area. CompendiumLD then creates an icon representing the file, and stores a link to the file so that if the user double clicks on the icon the file is opened in the relevant application (e.g. Word for .doc files, PowerPoint for .ppt files etc.).

However, if the user creates an SVG file and shares that either via e-mail or via the web, any links to local files on the users machine will not work. We therefore recommend that if aim is to share designs with embedded resources that the resources are stored in the cloud. Note that this does not require the resources to be publically accessible, they can still be protected by passwords and visible only to a limited audience. By taking this approach, the control of access to resources in a map can be handled on a resource by resource basis,; the security and privacy of each resource will depend on where it is located on the web. At one extreme on a designer might link only to open educational resources so all the resources will be freely accessible to anyone using the map. At the other extreme, all the resources may be password protected, e.g. in an institutional VLE.

Details about the SVG code structure for the View Pane

The View Pane is encoded as a SVG group element <g> with an identifier "ViewPane". Each map is encoded as a child group of this View Pane group. The visibility of a map is controlled by its "display" attribute. Initially the top level map is visible, so the value of the display attribute for this map is set to "inline" whilst the value of the display attribute for all other maps in the file is set to "none".

Each "mapview" group can contain group elements which represent nodes and links. Each node group has a class attribute the value   of which is set to the node type e.g. "reference", "position", "activity", "map" etc. Event driven operations are attached to each node or navigation panel element according to its class or id.

2.5   Documentation and design help

A series of resources have been created to support the use of CompendiumLD. All of these are available through the CompendiumLD webs site (though not all are hosted on the site itself). They include

- A screen cast explaining how to 'Get Started' with CompendiumLD http://www.slideshare.net/andrew_x/getting-started-with-compendium-ld-version-1, and another which describes its facilities for laying out, linking resources and timing information to leaning designs http://www.slideshare.net/andrew_x/doing-more-with-compendium-ld
- Tutorial guides that take new users step-by-step through the very first stages of starting and using CompendiumLD http://compendiumld.open.ac.uk/documentation/version1.0/tutorials/.
- A video-cast showing how the process of designing using CompendiumLD can be used to iteratively build, evolve and question a design (Paul Clark and Simon Cross 2008/2009)
- A quick reference guide for using CompendiumLD http://compendiumld.open.ac.uk/documentation/version1.0/QuickRefGuides/userguide.pdf (Cross, 2009)
- A 2 page briefing paper http://compendiumld.open.ac.uk/documentation/version1.0/QuickRefGuides/CompendiumLD-briefing-paper.pdf (Brasher, 2009).

2.5.1   Context sensitive help

During the course of the OULDI code to generate context sensitive help was developed for two particular contexts within CompendiumLD. The first context is one in which the user is adding and specify a task for a learner, the second is one in which the user is adding a tool to a learning activity map.

The context sensitive help for the first context, when a user is adding and specifying a task, may be generated by right-clicking on the node and selecting the 'LD help' menu option. An example of the help window generated for a particular task is shown in Figure 10. In this example, the user has typed 'Discuss' into the task label, and then selected the menu option 'LD help' prompts the application to pop up a window showing tools to support discussing and existing activities that include tasks which include the word 'discuss'. The set of tools shown in this help window are selected using a verb-to-tool look-up table based on verbs within a task taxonomy similar to that described by Falconer et al. (Falconer, Conole, Jeffery, & Douglas, 2006); the set of activities is generated by searching the database maintained by CompendiumLD for activities including tasks with 'discuss' in their label. Further help is provided by the 'About..' buttons. These buttons initiate a customised Google search of selected web sites (http://www.google.com/cse/home?cx=000971387191123125524%3Apep67nk6mi0). The web sites were chosen because of the quantity and quality of the information they provide about use of tools in learning and include sites such as http://www.learningdesigns.uow.edu.au/, http://www.educause.edu/ and Cloudworks. We adopted this pragmatic approach for a number of

reasons. To create our own hand crafted text would not only be time consuming but would suffer from quickly becoming dated. However the alternative of a free Google search arguably produced a daunting and untargeted set of resources. The middle approach we have adopted enables us to focus in on a small set of quality assured sites, which we have checked for relevance and which are likely to be sustained and updated in the near future. An aim of using a customised search external to CompendiumLD was that the search can be modified and used independently of CompendiumLD. One disadvantage of using the Google search is that potentially relevant resources which reside on the intranet (e.g. the learn about guides or OU Case studies) are not currently included in the results returned.
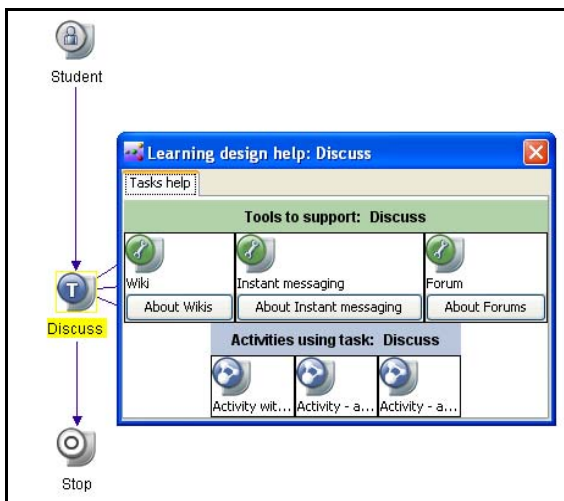

Figure 10: Help relevant to a particular task

Help related to tools that the designer drags and drops onto the window may also be shown. Figure 5 shows an example of help presented when the designer selects help for a 'Wiki' tool node.
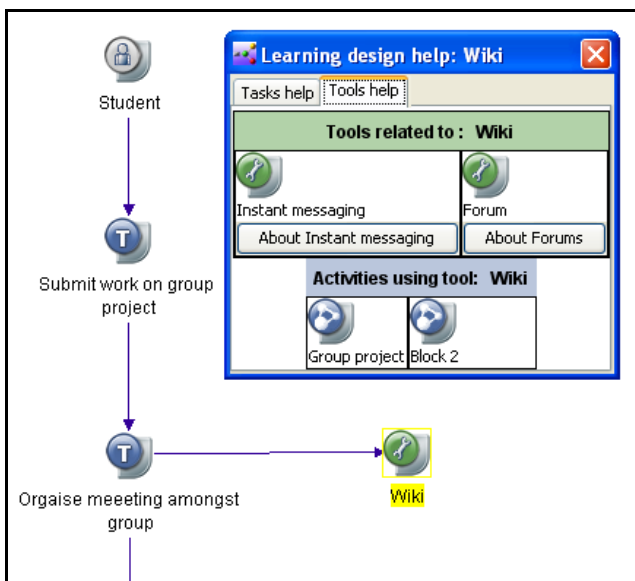

Figure 11: Help relevant to a particular tool

These two implementations of context sensitive help are not particularly sophisticated, in that they do not make a great deal of use of the contextual information available. For any task or tool within an activity, there will often be additional information available via the other nodes it is linked to. This additional information has not been used in the current implementation because there was not enough developer/designer time to extend the functionality to make use of it.

Other approaches to context sensitive help include that proposed by Laurillard (Laurillard, 2009) which suggests how a formal representation of an activity can be compared to theoretical descriptions of learning (such as Laurilllard's own conversational framework) with the aim of producing advice for the designer of the activity. This interesting work is at an early stage and may produce some ideas and outputs which can be utilised by the OULDI in general and CompendiumLD in particular. However, one key aspect of the Laurilard's approach is that it relies on a formal representation of an activity (e.g. a LAMS sequence) that can be evaluated against a theory. CompendiumLD differs in that the representations it produces are at most semi-formal: the tool itself places no restriction on the order, type or manner in which nodes are linked to represent a learning activity. This means that direct application of Lauriullard's approach to CompendiumLD will not be possible.

2.6   Installers

Installers have been created and tested for the Windows and Mac platforms. These installers use a platform specific GUI to guide the user through the installation process.

CompendiumLD has also been tested on the Ubuntu distribution of Linux and a zip archive has been made available to install it on this and other Linux distributions.

All three of these installation options are available from the download page of the CompendiumLD website.

2.7   Supporting users make the transition to designing visually

"*So for some 'getting their head around' CompendiumLD, or rather the representations it enables users to create, can be a significant change. The fact that many staff did not appear to have or be keen to learn visual techniques to map, understand and design module was a consistent observation across the pilots. The authors of the Cambridge Pilot Report concluded that to use CompendiumLD would require 'formal training' (something not provided in the Cambridge Pilot) to get used to the user interface and gain 'command of its underlying concepts of curriculum design.' This last point suggests that using CompendiumLD may require a conceptual frame as yet unfamiliar to many academics*"
(Cross, Galley, Weller, & Brasher, 2012).

To support people make the transition to design visually we have created a set of "Post-It" leaning design icons. A set includes several of each of the CompendiumLD activity, outcome, output, resource, and tool icons printed onto "Post it" notes, as shown in Figure 12. These "Post it" icons are intended to remove both the need for the user to have to think about the visual representation of the activity, outcome, output, resource, or tool itself, and the need to learn how to use CompendiumLD, thus allowing them to focus on visualizing the relationships between these items.

Figure 12   The CompendiumLD "Post-It" icons in use

These have been used in a few workshops but not formal evaluation has yet been carried out.

3   Development process, evaluation and usage

This section describes the way that data from testing and comments from users has informed CompendiumLD's development, and some quantitative and qualitative data about the extent and nature of usage of CompendiumLD is also presented. The history of changes made to CompendiumLD in reaction to the data collected is available on the CompendiumLD web site[4] (6 versions released from March 2009 to date). Lastly, technical aspects of the CompendiumLD development process are described (these are reflected on in the conclusions and recommendations section).

3.1   Developmental testing and evaluation

Over the course of the OULDI project several types of developmental testing and evaluation have been carried out:

- Surveys of media developers, editors and project managers (March and June 2009)
- Evaluation by a novice user following a semi-structured script (November 2009)
- Technical testing of installers (2009 and later)

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[4] http://compendiumld.open.ac.uk/documentation/history/

- Analysis of forum comments from students about their experience of use of CompendiumLD (2010 and later)

and these have been complemented by a less formal series of observations of use of CompendiumLD in workshops run by the OULDI team. These have also resulted in qualitative data which has been used to inform the design and production of the software.

This section provides some examples of how information about use of CompendiumLD has informed its developments.

3.1.1 Feedback from media developers

At the request of the Learning Media Design Programme run by the OU's Learning & Teaching Solutions (LTS) unit, OULDI delivered two workshops to mixed groups comprising of media developers, editors and media project managers during 2009. Three aims of the workshop were to introduce CompendiumLD, impress a favorable disposition towards it, and to explain and test a particular structure of laying out a course design. A questionnaire survey was undertaken immediately after the first workshop (hereafter termed the 'Workshop survey') and then later in the year an additional follow-up survey was sent to participants from both workshops (the 'Impact survey').
The next two sub sections describe outcomes drawn from those surveys and indicate the responses made. CompendiumLD version 0.66 was available at the time of the workshops, with version 0.75 being released some time after the second workshop occurred.

Workshop survey (n=19)

Users responded well to many aspect of CompendiumLD. Not only do these comments identify useful features of the software, they say something about what users are looking for in the practice of design visualisation. They liked:

- Basic operations [which] seemed quite straightforward...
- Starting template layout / the ability to have a background template which can be used to ensure that a course design conforms to a series of norms
- You can change the layout quickly and easily
- Clear visual layout / the general way that it lets you lay out a course visually
- It is useful for communicating the overall structure of a course / Project managers seem to find it useful to give them an overview of a course.
- Good for sharing ideas with others
- It was drag and drop and Icon-based / the ease with which you can connect related nodes to each other
- The ability to add time values to tasks in order to record and assess the total time needed to complete a even block or unit of work / timing features and text/note features.
- You can export the design in multiple ways - very handy!

At the first workshop around a third found Compendium easy to use, around half found it 'partially' easy to use whilst 18% felt 'still some work required'. Respondents were also asked what features they found more difficult. Their responses are listed below, and alongside the changes to CompendiumLD that have already been made in response are given in **_bold italics_**. In summary, as a response to this feedback most of the points outlined above have since been looked at or addressed in later versions of the software:

- Lack of normal cut / copy / paste shortcuts as per virtually every other program.
  CompendiumLD cut/copy and paste menus and shortcuts restructured so that copy and paste now work in a conventional way, and a menu item 'Paste special' introduced which effects a Compendium paste as transclusion operation.
- Difficult to save/export for sharing with colleagues
  Export Learning design file and Import Learning design file menu options introduced
- It is not always obvious what the icons should be used for / the icons themselves aren't very informative / add an asset icon / match icons to those used in LTS
  Getting started with CompendiumLD slideshow/video produced
- It doesn't always remember the timings you put in for activities / the timings didn't seem to work.
  Bug fixed
- It changes the layout when you close a map, so when you open it again the icons are no longer aligned neatly.
  Bug fixed
- I would like a labelling tool so it would be possible to write comments and attach them to particular icons / I'd like to show accessibility issues
  Getting started with CompendiumLD slideshow/video and other documentation produced which shows tagging and other node labelling possibilities
- '[For me] the user interface remains a bit of a half-understood concept and reading all documentations to formulate a sufficient know-how requires free time (time not well spent perhaps)'
  Getting started with CompendiumLD slideshow and short videos produced
- Better quality image export
  SVG images are now available from CompendiumLD. Their quality depends only on the viewing or printing device used.
- Distraction caused by the automatic help pop-up
  Automatic help pop-up disabled
- Additional help in using the software
  Help resources such as slideshows and tutorials have been developed

Impact survey (n=18)

In the impact survey, 15 of 18 respondents agreed or strongly agreed that CompendiumLD is a useful tool for learning design. However, only half had used CompendiumLD since the initial workshop suggesting either other forms of visualisation were being used or that the opportunity had not yet arisen. Of those who had used CompendiumLD before the workshop, 5 of the 7 did not use it afterwards. These findings were one of the reasons that the post-it icons were developed are discussed more in the conclusions (section 4).

3.1.2   Evaluation by a novice user following a semi-structured script

This evaluation was carried out in November 2009 using version 0.75 of CompendiumLD, and the findings were used to inform the development of version 1.0. It was carried out by a member of the OU's Institute of Educational Technology's Learning and teaching development team.
The person selected was chosen because they had no prior experience of Compendium or CompendiumLD, but did have experience of learning activities and courses from a range of different OU faculties gained through developmentally testing or studying them. This evaluator was asked to go through the experience of downloading, installing and trying to get to grips with CompendiumLD by

using the available documentation alone, and only to ask other people (e.g. the OULDI team) for help as a last resort; they did not. To put this evaluation in context the evaluator was asked to imagine that they were an academic on a course team whom the Course chair has asked to use CompendiumLD to design a new learning activity for their course. The evaluator was asked to pick a course that they had experience of, either through testing or studying it, and they chose the TU120 course. They downloaded and installed the application reporting that "the programme is easy enough to install and provides a clear explanation at the outset for its purpose". An example of one of several maps they created is shown in figure 10.
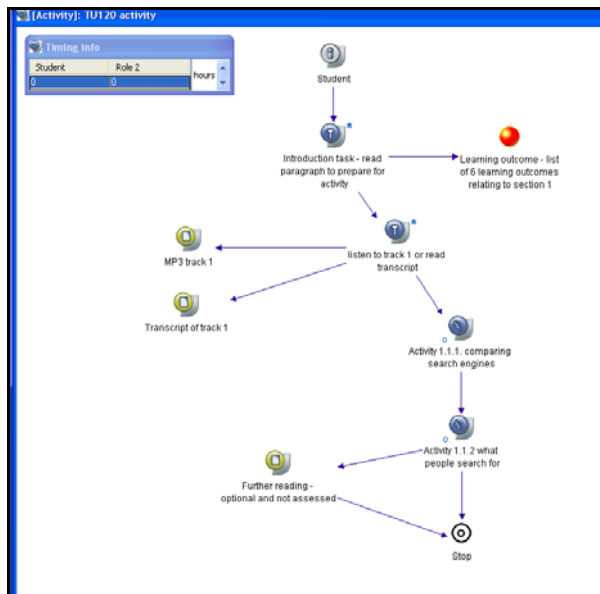

Figure 10: Example of CompendiumLD map of a TU120 learning activity created during developmental testing by a novice user

They recommended a number of changes to be made to the documentation for CompendiumLD, either embedded in the welcome maps or available online.

They stated that the welcome map does lead to helpful guidance quickly, though the two page user guide   does not include information about every node:

 'A complete list of nodes and definitions would be very useful – perhaps as a separate pdf if you want to keep the pdfs short'. The two pdfs (i.e. the *CompendiumLD briefing paper* and the user guide) 'were very useful and were well laid out; presenting guidance information in this way was great'. Other changes or additions to the documentation recommended included for the length of QuickStart videos on the 'quick start to compendium' map would be helpful.'

Overall, this semi-scripted evaluation gave us confidence that a novice user could install and use CompendiumLD with out receiving human help, but that improvements to the documentation were necessary to enable such a user to make best use of the tool. The findings from this evaluation have fed into the development of the documentation described in section 2.5.

3.1.3   Technical testing of installers

During the course of 2009 several users reported problems with installing CompendiumLD on Windows Vista. In November 2009 the Windows installer for CompendiumLD was tested on Windows

7 machines (64 and 32 bit). As a result of this testing, changes have been made to the information provided on the Windows download section of the CompendiumLD website, and to the information provided within the CompendiumLD Windows installer.

The changes made amount to advising the user that they need to have administrator privileges, and to right click on the Installer and select 'Run as administrator'. Provided the user follows this advice, the installation process will run for both Windows 7 and Windows Vista; the way it operates for Windows XP is not affected.

3.1.4   Students' comments on their use of CompendiumLD

An analysis of comments made by students about their experience of using CompendiumLD version 1.0 during "Technology-enhanced learning: practices and debates" an OU post graduate course, (code H800) was carried out during 2010 (Brasher, 2010).

This resulted in a series of recommendations for changes, of which some but not all have been accomplished during this project.

Recommendations with high priority

- Fix installation issue (problems seem to occur for some users of Windows 64 bit systems)
  Installer, instructions and guides have been modified.
- Unable to enter task timing information
  Bug fixed
- Improve facilities for sharing designs e.g. via 'the cloud'
  SVG solution implemented
- Changes to CompendiumLD documentation
  1. A one page getting started quickly guide available on the installation and download pages
     Completed

However, the following aspects of documentation remain to be completed

  2. More examples, including some with an explanation of the rationale for choice of and usage of the visual representation
  3. Examples of different design processes and ways in which visual representation/CompendiumLD can be applied (e.g. collaborative and individual processes).
     Clarify that even if the process of creating a visual design is useful, the resulting visual representation may not be immediately useful for communicating ideas.
  4. demonstrate aerial view in a video or slide show, and show how it can be used to keep track of a big complex map.

Nice to do, but lower priority (these have not been implemented within the OULDI project due to time and resources available)

- Extend functionality of CompendiumLD to facilitate the representation of loops (by introducing curved links for example)
  Compendium 2.0 beta offers curved links, but the curve shape is fixed, and not suitable for drawing loops. We think a more flexible solution is needed for learning design, and because of the effort involved this was not attempted during the project
- create other models and templates e.g. an activity theory stencil
  An activity theory stencil has been implemented within another project (see section 7.2)
- Facilitate addition of visual indicators to represent task types, e.g. reflection etc. One student used different label colours

3.2   Usage

3.2.1   Quantitative data

Statistics retrieved on 31st July 2012 show that 2272 users (according to distinct e-mail addresses given at time of download) had downloaded CompendiumLD since it was first made available via the CompendiumLD website on 21st August 2008.

Initially, data about the platform and download date were not collected. However, from 8th October 2009 these pieces of information were added to the information collected as users downloaded the CompendiumLD software.

Table 1 Number of downloaders by distinct email address according to platform between 8th October 2009 and 31st July 2012

Platform	Number
Windows	1529
Mac OS	326
Linux	63
Total	1918

Table 2 Number of downloaders by year between 8th October 2009 and 31st July 2012

Year	Number
Oct 2009 – Oct 2010	740
Oct 2010 – Oct 2011	795
Oct 2011– July 2012	454

In addition, we have some statistics concerning items of CompendiumLD documentation that was described in section 2.5. These statistics are shown in Table 3.

Table 3 Number of views and downloads of CompendiumLD screen casts between 8th October 2009 and 31st July 2012

Resource	Date published	Views	Downloads
A screen cast explaining how to 'Get Started' with CompendiumLD	Jan 2010	4985	50
A screen cast which describes its facilities for laying out, linking resources and timing information to leaning designs	Feb 2010	2307	29
A video-cast showing how the process of designing using CompendiumLD can be used to iteratively build, evolve and question a design	Nov 2009	2234	4

3.2.2   Examples of use

It is difficult to be sure how many of those who download the CompendiumLD software actually use it. Several examples of positive feedback about it indicating use (as opposed to just trying it out) are given in the evaluation report (Cross, et al., 2012), and remarks made by a few of the people within the reasons for interest in CompendiumLD field on the download form indicate that the users in question are downloading it again because they have found it useful.

There have been several examples of its use outside of the OULDI that we have become aware of. For example, CompendiumLD has been used in the Master of Science in Learning and Teaching Technologies course offered by the University of Geneva during 2012, 2011 and 2010. Examples of the activities that students have to undertake are available on the university's edutech wiki (see e.g. Université de Genève, 2012) and designs produced by students of the course are also available via the same wiki[5]. Also, CompendiumLD was used for the design of Elluminate tutorials in the ATELIER-D project (Jones & Holden, 2011).

3.3   Technical aspects of the development process

Compendium (and CompendiumLD) are Java applications. Our development is based on the source code of the latest full release of Compendium (Compendium version 1.5.2) as developed by KMI, but some functionality derived from the Compendium 2.0 beta code base has also been integrated to add to the functionality provided by Compendium 1.5.2. The source code for CompendiumLD is stored in the same code repository as the core Compendium code[6]. The other files needed to build the application (image files, third party code libraries etc.) are also stored in this repository.

4   Conclusions, challenges and recommendations

Many iterative changes have been made to CompendiumLD over the duration of the project, resulting in the release 6 versions since March 2009. The changes made have been informed by evidence collected from surveys, analysis of users' comments, formal evaluations, and informal evaluation at workshops as explained in section 3. The statistic presented in section 3.2.1 show that it has been downloaded over 2000 times since August 2008, and that two items of documentation have been viewed several thousand times each, and downloaded several tens of times each. It has also been adopted and used by the University of Geneva in their Master of Science in Learning and Teaching Technologies course every year since 2009.

However, it has not achieved wide spread adoption. Data from the pilots indicates that several of the pilot participants found CompendiumLD useful (Alberts, Sharma, & Parnis, 2011; Papaefthimiou, 2012) and comments received via blog posts, in the download form from users downloading it for a second or greater time, and informally, reveal that there are a small percentage of enthusiastic users.
Why has there not been wider adoption?
Some potential users regard the overhead of learning to use the software as too high. To counter this, we have recently introduced the "Post-it" learning design icons described in section 2.7.
Another reason is that whilst many potential users are initially attracted by the idea of representing learning designs visually (e.g. when first introduced to the idea at workshops), it is not an approach that is suited to all design problems. It is suited to situations where there many design choices (e.g. a free choice of tools, resources, teaching approach etc.), and these situations typically occur at the beginning of a design process. CompendiumLD has been developed as a tool for creating and experimenting with models, not implementations of leaning designs. It has been developed to allow users to model complex relationships between different aspects of a learning and teaching process, to do this in a relatively flexible and unconstrained way, and to allow individuals and teams to think ideas

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[5] This search produces examples of students' work i.e. their 'rapports'
https://www.google.com/search?hl=en&lr=&noj=1&biw=1024&bih=637&q=compendiumld+rapport+11+site%3Aunige.ch&oq=compendiumld+rapport+11+site%3Aunige.ch
[6] http://compendium.open.ac.uk/subversion

through before committing to implementation. It facilitates the linking of existing web and other graphical and document resources into a design, and supports complex multi layered structures. Challenges for the future include

- Reconsider context sensitive help
  Early in the project we implemented some context sensitive help intended to support the designer during the design process (section 2.5.1). Feedback from users was not positive, and the growth of Cloudworks and other sources of design help on the web led to a decision to focus effort on visual modelling and representation rather than context sensitive help. However, work by other s in this area has progressed since (see e.g. Charlton & Magoulas, 2010) so this will be worth revisiting in the future.
- The documentation produced so far has focused more on "how to", not why a visual approach to design should be adopted in particular situations. We need to update the web site and documentation to include more of the underlying rationale , and also offer particular guidance to help users to choose between different starting points for their visual designs. One example of the kind of thing that has been tried in face-to-face situations is the 'Design Activity In A Box' (Cross, et al., 2012, p. 66); it is supporting material of this nature that we need to include within the CompendiumLD site.
- The decision to go for a web friendly sharing mechanism (section 2.4.2) instead of a fully web-based editor was forced by resource limitations, but the basis for a web based editor has been laid should the opportunity to develop it arise.
- Further work on investigating if use of the "Post-It" leaning design icons does help people make the transition to designing visually, or if other approaches may do so .

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6   Acknowledgements

7   Appendix 1: Recent developments

Two stencils have been developed in the last months of the project in collaboration with the Maseltov
project[7].

7.1   Places stencil

The places stencil is used to show the place at which learning occurs, to model and plan instances of
mobile learning. This was developed in collaboration with another project. The icons were obtained
from the Noun project.

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[7] http://www.maseltov.eu/

Node name	Icon	Description
Church		Denotes location of learning as: within a church or church grounds.
City		Denotes location of learning as: within a city.
Home		Denotes location of learning as: at home.
Museum		Denotes location of learning as: in a museum.
On the bus		Denotes location of learning as: on a bus.
Shopping		Denotes context of learning as: whilst shopping.

7.2   Activity theory stencil

To be completed.