

# ***An overview of design representations***

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## **Abstract**

This paper provides an overview of the range of representations that can be used to describe learning designs. It provides a definition for learning designs and demonstrates how the different representations can be used for different levels of granularity and to foreground different aspects of the design process.

## **Keywords**

Learning design, representation, design methods, visualisation

## **Understanding the design process**

New technologies have the potential to enhance the student learning experience significantly; offering new ways in which students can communicate and interact with each other and with their tutors. However, the sheer variety of new technologies available now is bewildering. Those tasked with designing the learning experience need new forms of guidance to take advantage of the affordances of new technologies and to make pedagogically informed design decisions. Learning design as a research field has emerged in the last five years, as a methodology for both articulating and representing the design process and providing tools and methods to help designers in their design process (see Beetham and Sharpe, 2007; Lockyer et al., 2008 edited collections). This paper looks at a particular sub-section of learning design research; namely the area looking at design representations (see Botturi and Stubbs, 2008 for an edited collection on visual design languages). The paper will begin by looking at existing practices in designing learning activities and whole curricula and will argue that on the whole, such design practice tends to be implicit and practice-based. I will put forward the argument that there is a value in making designs more explicit and formalised and will go on to describe a range of design presentations. I will provide examples of each representation and will discuss how different representations can be used. The paper is intended to act as a positional piece alongside the other papers presented in this symposium.

## **The OU Learning Design Initiative**

The work presented in this paper comes out of the OU Learning Design Initiative (OULDI) (<http://ouldi.open.ac.uk>), which is developing an empirically based methodology for learning design, which aims is to produce a range of tools, methods and approaches to help teachers make more informed design decisions. Tools produced include a visualisation tool (CompendiumLD and Cloudworks, a site for sharing and discussing learning and teaching ideas and designs). The work is underpinned by empirical work, aimed at getting a richer understanding of educational design processes. Data collected includes interviews, surveys, observations, web statistics, focus groups, as well as gathering data at workshops and other events we run. The empirical data informs the 3 main strands of our work: representing pedagogy, guiding the design process and facilitating the sharing and discussing of designs. Conole (2009) describes the origins of OULDI. Conole, Brasher et al. (2008) describe CompendiumLD and how it can be used to help make designs more explicit. Conole and Culver (2008) describe the design and evaluation of the Cloudworks site. Related to this work is the OLnet initiative (<http://olnet.org>), which aims to provide a global network of support for researchers and users of Open Educational Resources (OER). An important strand of OLnet's work is to apply learning design and pedagogical patterns research to an OER context. Initial findings from are described elsewhere (Conole and McAndrew, 2009; Dimitriadis et al., 2009; Conole et al., submitted).

## The problem with design

I have argued (Conole, 2008a) that there is a gap between the potential of technologies for learning and their actual use in practice. Teachers lack the necessary skills to make informed judgements about how to use technologies and are bewildered by the possibilities. In a series of interviews with teachers, focusing on their design practices, we gained a richer understand of existing design practice (Cross et al., 2008). What is evident is that design is a creative, messy and iterative process. Teachers rely heavily on prior knowledge and experience in their design practice and rarely follow any kind of formal design method process. This isn't problematic in situations where the teachers are working within known parameters, but is problematic when they need to derive new designs within an increasingly complex learning context, where there is an almost infinite number of resources and tools they can draw on. Indeed closer scrutiny of a learning activity reveals that it is made up of a significant number of sub-components, which need to be considered in the design process (Conole, 2008). These include the type of pedagogy being used, the context in which the learning activity will be enacted, the types of intended learning outcomes associated with the activity, the nature and number of tasks to be undertaken by the learner, the associated tools and resources they will use and any formative or summative assessment. Furthermore each of these sub-components have inter-dependencies; the kinds of pedagogy chosen will influence the tasks undertaken by the student; different tools have different affordances and will influence the learning experience, assessment is often a key driver in learning and hence the nature of the assessment has a significant influence on the way in which the learner will engage with the learning activity.

Learning Design as a term originated in the technical community and began to gain prominence around 2004, following the development of the educational mark-up language at the Open University of the Netherlands. Since then others have appropriated it in a much broader sense, shifting to the notion of 'Designing for Learning'. Cross and Conole (2008) provide a simple overview of the field. The focus of the research is to both better understand and represent design processes, along with developing tools and methods to help practitioners create better designs. A number of benefits of adopting a more formal and rigorous approach to design have been identified (Conole, 2009). In terms of the OULDI research work, we define learning design as:

A methodology for enabling teachers/designers to make more informed decisions in how they go about designing, which is pedagogically informed and makes effective use of appropriate resources and technologies. This includes the design of resources and individual learning activities right up to whole curriculum level design. A key principle is to help make the design process more explicit and shareable. Learning design as an area of research and development includes both gathering empirical evidence to better understand the design process as well as the development of a range of resource, tools and activities.

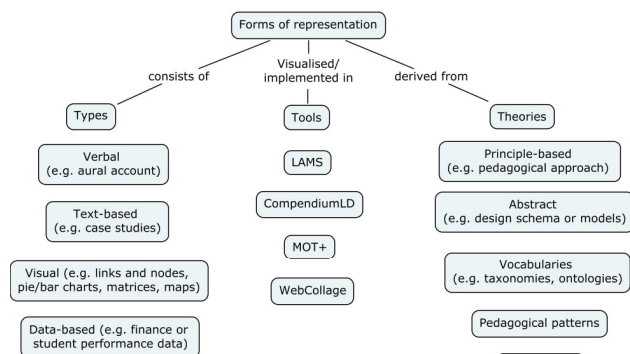
We see 'learning design' as an all encompassing term to cover the process, representation, sharing and evaluation of designs from lower level activities right up to whole curriculum level designs. In previous work (Conole and Jones, 2009) we identify three levels of design: micro, meso and macro, drawing on Bielaczyc (2006) and Jones (2007). In our terms, the micro-level refers to learning activities (typically a few hours worth of activity), the meso-level to aggregations of activities or blocks of activities (weeks or months worth of activity) and the macro-level to whole curriculum designs. As part of their Curriculum Design programme the Joint Information Systems Committee (JISC) provide the following definition in terms of curriculum (JISC, nd):

'Curriculum design' is generally understood as a high-level process defining the learning to take place within a specific programme of study, leading to specific unit(s) of credit or qualification. The curriculum design process leads to the production of core programme/module documents such as a course/module description, validation documents, prospectus entry, and course handbook. This process involves consideration of resource allocation, marketing of the course, and learners' final outcomes and destinations, as well as general learning and teaching approaches and requirements. It could be said to answer the questions 'What needs to be learned?', 'What resources will this require?', and 'How will this be assessed?'

## Types of representation

Learning designs can be 'represented' or 'codified' in various ways; each representation will articulate particular aspects of the learning that the designer anticipates will take place. Each design representation foregrounds different aspects of the inherent 'master' design. These forms of representation range from rich contextually located examples

of good practice (case studies, guidelines, etc.) to more abstract forms of representation that distil out the ‘essence’ of good practice (models or patterns). This section describes what is meant by ‘design representation’. It gives an overview of the different types of representations; the formats they can be presented in, the level of granularity of design they portray and an indicate of the particular ‘lense’ each representation provides on the inherent ‘master design’. Conole and Mulholland (2007) outlined a number of common representations. These included essentially practice-focussed representations (e.g. case studies, lesson plans and patterns), conceptual representations (e.g. mind maps and models), more abstract representations (e.g. and vocabulary) and technically orientated representations (e.g. UML diagrams). There are a number of uses of these, to enable: educational researchers to analyse and develop educational innovations, teachers to plan lessons, software designers to instantiate lesson designs in software or learners to understand what they are doing. The type of representation is crucially dependent on its purpose.



This paper builds on this work and describes different types of representations and how they can be used. This figure provides a more generic description of the types of representation. Four main types of representations are identified: verbal, textual, visual, or data-based. A range of tools is now available to help visualise designs and in some cases, actually implement designs. Four examples are shown. LAMS (<http://lams.org>) uses a link and node visualisation, but because LAMS sequences are ‘runnable’ the basic components of the system are tool-focussed. CompendiumLD (<http://compendiumld.open.ac.uk>) is also link and node based, but can be used across a broader range of

granularity of designs, CompendiumLD maps can be exported in a variety of formats, but are not directly runnable. MOT+ is a graphical language and editor, which helps define activity sequences, actors and tools (Paquette et al., 2008). Finally WebCollage visualises pedagogical patterns taking a metaphorically based approach to visualise designs around their description, such as ‘pyramid’ or ‘jigsaw’ (Hernández et al. 2005, 2006). Many representations are primarily practice-orientated in nature, however some have a particular theoretical basis. For example, designs which explicit align with a particular pedagogical perspective such as constructivism or pedagogical patterns which have a prescribe format and are based on an underlying theoretical perspective based on the work of Alexander (see for example Alexander et al, 1977; Goodyear, 2005). Vocabularies (see for example Conole, 2008a) and abstract representations such as design schema (see for example Conole, 2008b) and pedagogical models, such as Laurillard’s conversational framework (Laurillard, 2002) are also examples of representations that are based on theoretical perspectives. Whilst clearly this is not a perfect classification it does give some indication of the breadth of types of representation that are possible.

Representations can have different formats, can be used to describe different aspects of the design lifecycle and can provide different lenses on the inherent design, foregrounding specific aspects:

- Formats: these can include different types of text-based representations (e.g. case studies or narratives), visualisation representations (e.g. node-link types representations, design schema or metaphorical), numerically focussed (e.g. pie or bar charts based on underlying numerical data), representations based on other forms of media (e.g. audio or video) or representations can be a combination of the above.
- Levels: Designs can describe small-scale learning activities (which might describe a few hours worth of learning) or scale up to a description of a whole curriculum (across a three-year undergraduate degree course or a one-year masters course)
- Lenses: The focus might be on the nature of the tasks being undertaken and associated tool and resources, on the overarching pedagogical principles, mapping different components of the design or relating to specific data (such as financial or student performance data).

Conole and Mulholland (2007) further classified representations into three levels.

At a simplistic level this has an educational component (the pedagogical intention and aspiration) and a technological component (what technologies will be used, how and their associated affordances). A meditational layer, which describes the process or operational dimension, provides the link between these.

They go on to suggest that the educational view provides the underlying pedagogical/inquiry model (such as the learning outcomes and pedagogical approach). The Process-based/Operational view focuses on enactment of the design. Examples include representations that are essentially stage-based (where the focus is on what is happening in a temporal sequence), or schema-based (which not only outlines the sequential set of tasks, but also the and associated roles, resources, tools and outputs). The final technical view, they argue, provides the ‘technical implementation blueprint’ and the rule-based/runtime of the data flow.

## Examples of different types of representation

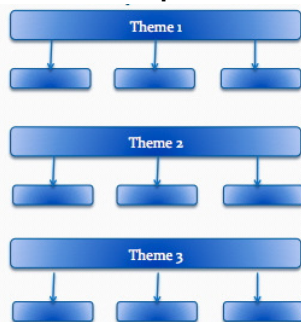
This section describes a set of recent representations that we have developed as part of learning design research. It will describe each representation, provide an illustrative example and suggest how that representation can be used. The 7 representations presented here are not intended to be comprehensive, but to give a flavour of the variety of representations and an indication of their uses. They cover the spectrum of different types of format, level and lenses described earlier (Table 1).

Representation	Format	Level	Lens
Textual summary	Text	Macro	Descriptive overview
Content map	Node-link	Meso, macro	Content hierarchy & structure
Task swimlane	Node-link	Micro	Tasks breakdown: roles, tasks, associated tools/resources
Pedagogy profile	Bar chart		Design method: student tasks
Principles matrix	Matrix		Design method: principles overview
Component map	Node-link	Meso	Map of aims & course cohesion
Course map	Pyramid	Macro	Pedagogy overview

### 1. Textual

This is the standard ways in which course are represented. It can range from a brief textual overview plus descriptive keywords through to more a more detailed breakdown of the curriculum covered. Such textual representations are common and form the basis of most course descriptions. Textual descriptions can also be used to indicate the pedagogical intent of the course or can be aligned to a particular theoretical basis, as is the case with pedagogical patterns, which follow a particular style and format.

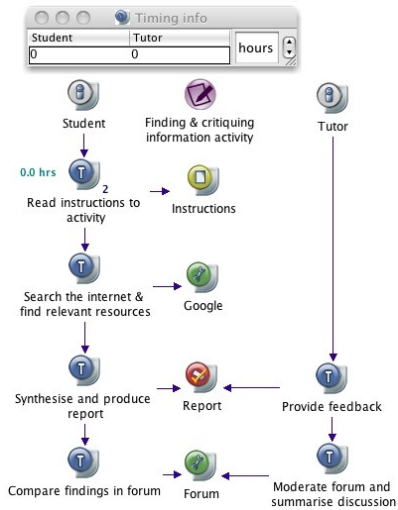
### 2. Content map



Another common way of representing designs is in terms of content. Content can be organised in a number of ways, but a particularly helpful one is to organise it into a series of themes and sub-themes, although alternatives are possible that can be temporally based or metaphorically based for example. Buckingham Shum and Okada (2007; 2008) show how the Compendium software tool can be used to represent content (See <http://openlearn.open.ac.uk/course/view.php?id=2824#section-4>). The textual and content mapping representations are probably the most common ways in which teachers think about their designs. However, taking a more activity-focussed approach about using different tools/resources requires other representations.

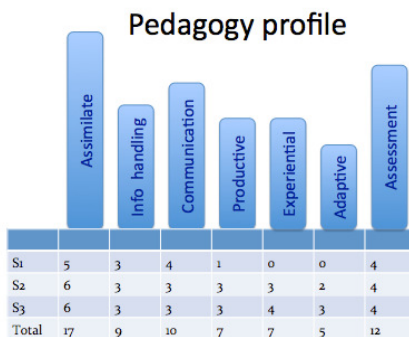
### 3. The Task swimlane representation

Representation at the level of learning activity was now fairly well understood. Our own representation at the activity level is based on an underlying learning activity taxonomy (Conole, 2008), which describes the components that need to be addressed when designing at this level (such as the tools and resources involved in the activity, the kinds of task the students will do, the roles of those involved, etc.). Whilst some of these components scale up to the level of curriculum design, this level brings additional levels of complexity – how can you map across the design process, what are the relationships between the different components at this level and what are the interdependencies?



The task swimlane representation is useful in terms of designing at the learning activity level. The figure shows a simple task swimlane representation drawn in CompendiumLD. Each role has an associated line of tasks and associated tools and resources. This is an example of what McKim (1980) categorises as link-node diagrams, where concepts/entities are represented as nodes and where the connections between the nodes have meaning. In our work so far nodes and links have been given equal weight, but it is also possible to use size or boldness as a means of conveying relative importance. The core learning design icon set in the tool are derived from an underlying learning activity taxonomy (Conole, 2008a). The tool also includes embedded help features and can be exported in a number of formats (see Conole et al. 2008 for more on CompendiumLD). Task swimlines can also be used to describe activities based on specific design types. For example the ‘Think-pair-share’ pedagogical pattern represented by Hernández et al. (2005) as a metaphorical visualisation, can also be represented as a task swim-line (<http://cloudworks.ac.uk/cloud/view/1800>).

#### 4. Design method: the pedagogy profile

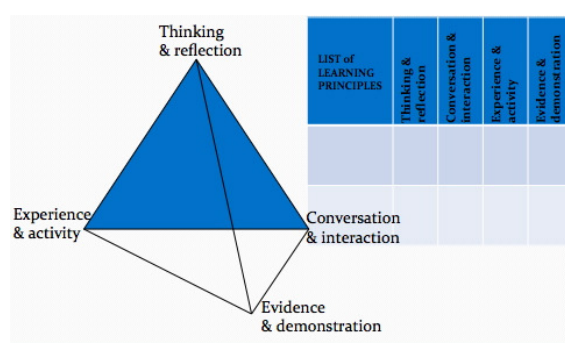


The pedagogy profile is a worked up version of the media advisor toolkit developed some years ago (Media Advisor, nd; Conole and Oliver, 1998), modernised against task types developed as part of recently developed learning activity taxonomy (Conole, 2008). In essence there are six types of tasks learners can do:

- Assimilative – reading, listening, viewing
- Information handling – manipulating data or text
- Communicative – discussing, critiquing, etc
- Productive – an essay, architectural model, etc
- Experiential – practising, mimicking, applying, etc
- Adaptive – modelling or simulation

In addition, learners undertake some form of assessment activities. You can then use these to create a pedagogy profile for a course – indicating the proportion of each type of tasks. An interactive pedagogy widget is now also available in the Cloudworks site (<http://cloudworks.ac.uk/index.php/cloud/view/2459>)

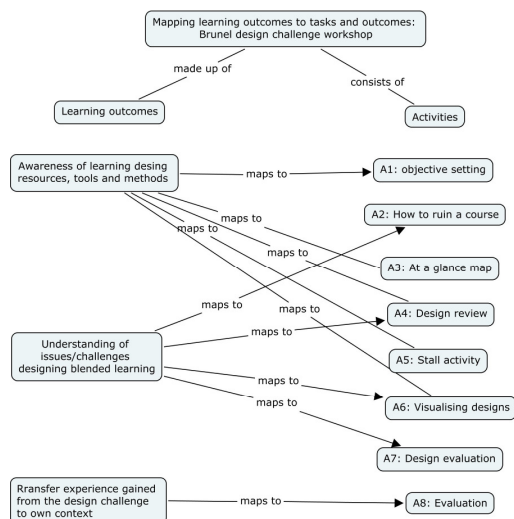
#### 5. Design method: Principles/pedagogy matrix



This representation articulates the pedagogical approach being adopted by the course and the overarching principles (See Conole, 2008b for more details). It provides a matrix that maps the principles of the course against four macro-level aspects of pedagogy. Principles might be generated/articulated by the course team (for example getting the students to reflect on experience and show understanding or incorporating frequent interactive exercises and feedback across the course) or might be derived from theory or empirical evidence (for example the REAP assessment principles (Nicol, 2009).

Variants on the matrix are also possible. For example mapping principles to course activities, or mapping the principles to a different set of pedagogical characteristics (for example Bloom’s educational taxonomy, the REAP principles or Laurillard’s conversational framework).

## 6. Component based map

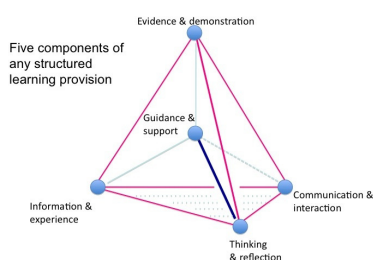


In addition to mapping at the level of individual activities it is also important to be able to map at the meso- and macro-level in terms of mapping different components of the course; such as learning outcomes, content, activities and assessment. Standard mind mapping and concept mapping tools can be really helpful in laying out and making these kinds of connections. A number of different configurations and layouts can be envisaged. The figure shows a mapping of learning outcomes to activities for a recently run blended design workshop (see the following set of web pages <http://cloudworks.ac.uk/index.php/cloudscape/view/1912> for more details on the workshop and activities). Sherborne (2008) argues that ‘concept mapping could help curriculum developers and teachers at various stages of the [design] process. The ability of maps to focus on key ideas and their connections may help curriculum designers to survive better the translation into classroom experience and promote collaborative working methods.’

## 7. Course map

The course map representation gives an ‘at a glance’ overview of the course. The representation is based on articulation of the gross-level aspects of what the learner is doing and how they are learning

(information/experience, communication/interaction and thinking/reflection), the guidance/ support they receive and the way in which they are expected to evidence/demonstrate their learning. A 3D-representation of the course map nicely illustrates the relationship between the three aspects of student learning and the overall guidance/support and the ultimate evidence/demonstration of their understanding. The representation enables you to describe the course in terms of the types of learning activities the learner is undertaking as well as the guidance and support provided and the nature of any assessment. The table below describes the five facets of the representation in more detail. Essentially the guidance and support acts as the ‘learning pathway’ and might include details on the course structure and timetable or links to a course calendar or



study guide. Information/experience translates to the content of the course and what the learners are doing, communication/interaction to the social dimensions of the course and thinking/reflection to meta-cognition. Finally it may take the form of diagnostic, formative or summative assessment.

The representations presented here have been trialled in a number of venues and appear to provide robust and useful

representations. Representations 1 and 2 are fairly well established, but as discussed earlier new visualisation tools are enabling practitioners to represent content in ever more creative ways. The task swimlane representation for example has been used extensively and is built into our visualisation tool CompendiumLD (Conole et al. 2008). The pedagogy planner and the course map representations were used at a Blended Design Challenge workshop, to help guide teams to design (http://cloudworks.ac.uk/cloud/view/2640). A 3D ‘task-in-context to pedagogy’ map has been produced, based on earlier work (see Conole et al., 2004 and Conole, 2008) and we have also been exploring data-derived representations such as views based on financial data for a course or student performance data (See

Course map representation	
Guidance and support	<b>"Learning pathway"</b> Course structure and timetable Course calendar, study guide, tutorials
Information and experience	<b>"Content and activities"</b> Could include course materials, prior experience or student generated content Readings, DVDs, podcasts, lab or field work, placements
Communication and interaction	<b>"Dialogue"</b> Social dimensions of the course, interaction with other students and tutors Course forum, email
Thinking and reflection	<b>"Meta-cognition"</b> Internalisation and reflection on learning In-text questions, notebook, blog, e-portfolio,
Evidence and demonstration	<b>"Assessment"</b> Diagnostic, formative and summative Multiple choice quizzes, TMAs, ECA

<http://cloudworks.ac.uk/index.php/cloudscape/view/1907> for more details). We have also evaluated a series of workshops exploring the use of these design representations with pedagogical patterns work (Dimitriadis et al. 2009; Conole et al. 2010).

## Towards a more coherent classification of representations

Representing design in a range of formats, beyond simple text can help practitioners to think more creatively about their designs and can lead to new insights and understandings. There are parallels with Vygotsky's notions of language as a mediating artefact, 'thought is not merely expressed in [drawings], it comes into existence through them' (quoted in Stubbs and Gibbons, 2008: 37). This paper has attempted to categorise and outline a number of representations and their purposes. The selection chosen attempts to cover the full spectrum of designs: from learning activities to whole curriculum designs. But as Stubbs and Gibbons (2008: 46) point out 'As important as drawing may be to the design process, it rarely stands alone. Design drawings are nearly always accompanied by narrative, which supplements and adds meaning.' They quote Bruner 'We organise our experiences and our memory of human happenings mainly in the form of narrative – stories, excuses, myths, reasons for doing and not doing and so on.' whereas visual representations, on the other hand, 'can render phenomena, relationships and ideas visible, allowing patterns to emerge from apparent disorder to become detectable and available to our senses and intellect.' This paper has described some of the recent work we have been doing in terms of describing designs. It has contextualised this in broader work in the field. It is evident that there is currently a lot of interest in this area and that we are moving towards a clearer understanding of different types of representations and how they can be used. This section puts forward a draft classification of these representations.

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