Mod4L Final Report: Representing Learning Designs

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1 Introduction

The Mod4L Models of Practice project is part of the JISC-funded Design for Learning Programme. It ran from 1 May – 31 December 2006. The philosophy underlying the project was that a general split is evident in the e-learning community between development of e-learning tools, services and standards,

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and research into how teachers can use these most effectively, and is impeding uptake of new tools and methods by teachers. To help overcome this barrier and bridge the gap, a need is felt for practitioner-focused resources which describe a range of learning designs and offer guidance on how these may be chosen and applied, how they can support effective practice in design for learning, and how they can support the development of effective tools, standards and systems with a learning design capability (see, for example, Griffiths and Blat 2005, JISC 2006). Practice models, it was suggested, were such a resource.

The aim of the project was to: *develop a range of practice models that could be used by practitioners in real life contexts and have a high impact on improving teaching and learning practice*.

We worked with two definitions of practice models. Practice models are:

1. *generic approaches to the structuring and orchestration of learning activities. They express elements of pedagogic principle and allow practitioners to make informed choices (JISC 2006)*

However, however effective a learning design may be, it can only be shared with others through a representation. The issue of representation of learning designs is, then, central to the concept of sharing and reuse at the heart of JISC's Design for Learning programme. Thus practice models should be both *representations of effective practice*, and *effective representations of practice.* Hence we arrived at the project working definition of practice models as:

2. *Common, but decontextualised, learning designs that are represented in a way that is usable by practitioners (teachers, managers, etc).(Mod4L working definition, Falconer & Littlejohn 2006)*

A learning design is defined as the outcome of the process of *designing, planning and orchestrating learning activities as part of a learning session or programme (JISC 2006)*[6]*.*

Practice models have many potential uses: they describe a range of learning designs that are found to be effective, and offer guidance on their use; they support sharing, reuse and adaptation of learning designs by teachers, and also the development of tools, standards and systems for planning, editing and running the designs.

The project took a practitioner-centred approach, working in close collaboration with a focus group of 12 teachers recruited across a range of disciplines and from both FE and HE. Focus group members are listed in Appendix 1. Information was gathered from the focus group through two face to face workshops, and through their contributions to discussions on the project wiki[7] . This was supplemented by an activity at a JISC pedagogy experts meeting in October 2006, and a part workshop at ALT-C in September 2006. The project interim report of August 2006 contained the outcomes of the first workshop (Falconer and Littlejohn, 2006).

The current report refines the discussion of issues of representing learning designs for sharing and reuse evidenced in the interim report and highlights problems with the concept of practice models (section 2), characterises the requirements teachers have of effective representations (section 3), evaluates a number of types of representation against these requirements (section 4), explores the more technically focused role of sequencing representations and controlled vocabularies (sections 5 & 6), documents some generic learning designs (section 8.2) and suggests ways forward for bridging the gap between teachers and developers (section 2.6).

All quotations are taken from the Mod4L wiki[8] unless otherwise stated.

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[6] Thus we follow emergent convention here in distinguishing between "learning designs" (lower case "l" and "d") as defined above, and Learning Designs which are a specific representation of learning design conforming to the IMS LD specification

[7] http://mod4l.com/tiki-index.php

[8] http://mod4l.com/tiki-index.php

2 Issues of Representation

2.1 Outcomes of Interim Report

The June workshop focused on issues of sharing and reuse, and on what teachers require of an effective representation. The outcomes are described in detail in the interim report (Falconer & Littlejohn 2006) and are summarised here:

a) Different representations are suited to different purposes, communities and audiences
b) An effective representation for sharing and reuse has not, so far, been developed, even in FE where sharing and reuse are institutional norms
c) The amount and structure of information required to reuse a learning design is too complex for a single representation. Multiple representations that convey information in different ways are necessary.
d) Representations also need to support multiple levels of granularity, with the ability to drill down through any component to further detail. Detail provided in this way might include location of resources, video or audio clips, reflective notes, key points for delivery, etc.
e) Teachers find generic designs generally unhelpful: they not give sufficient insight into the dynamic process of instantiation and appear boring; contextualised examples are better at conveying this information, if only tacitly[9].
f) Many of the things that teachers most want to know about when assessing designs for reuse, such as rationale, assessment policies, reflection and evaluation, and student outputs and feedback, are scarcely covered, if at all, in most existing representation forms.
g) Timings, variation and contingency plans are of crucial importance for teachers instantiating designs, yet are seldom provided for in existing representation forms.
h) Even when a representation is broadly teacher-friendly and in a format with which they are familiar, small details of presentation (e.g. language, white space, etc) can prove a great barrier to use.
i) Electronic representations that support multiple perspectives, drilling down, etc should be in a ubiquitous and interoperable file format

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In the rest of this section we explore these issues, and try to develop a conceptual understanding of them, structured around four broad headings:

1. The purpose of the design (a, c, e, g, h)
2. Design as a product versus design as a process (b, f)
3. Granularity (c, d)
4. Communities (e, i)

2.2 Purpose – runnable versus inspirational representations

If we return to the initial definition of practice models as *generic approaches to the structuring and orchestration of learning activities …[which] support effective practice in design for learning* (JISC 2006), with the implication that these would support sharing, reuse and improved teaching practice, then practice models have at least three concurrent purposes. They are expected to:

- Be generic
- Detail sequence and orchestration
- Inspire teachers to implement them and hence change practice
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While there are plenty of examples to show that any two of these requirements can be realised together, achieving all three at once appears to be a holy grail. We can begin to understand why this might be when we consider the purposes of practice models in more depth. The three ostensible purposes are superimposed on an unresolved dichotomy of purpose between representation for design, and representation for staff development. This distinction has been characterised as that between representing in order to inspire a teacher into developing a new teaching approach, and

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[9] This point is substantiated by reports from other intitiatives, eg. Dalziel (2006). Experience from the AUTC project suggests that the ratio of contextualised to generic sequence downloads is around 10:1 (Lori Lockyer, private communication)

representing in order to run a design, either using a teacher or a machine – the "inspirational" versus the "runnable" design[10].

This parallels the controversy that has also surfaced at Design for Learning programme meetings[11], over whether we are designing for learning (the runnable design) or designing for teaching (the inspirational design) – that inspirational designs are intended for use and interpretation by a teacher while runnable designs are intended for direct use by learners. In the latter case the mediation of the machine is invisible, providing there is enough detail in the representation to make sure it 'works'. This makes the representational problems seem much more tractable or at least makes them simple problems of standardisation. However, even 'runnable' designs are usually supported and mediated by a teacher or by some supportive context of study, hence it may be necessary for the machine-readable representation to be augmented by representations intended for a human actor, whether the teacher or the learner.

These distinctions raise the issue of the audience for the representation. Even if the purpose is to reproduce a runnable design, the needs of those implementing it – teacher or machine – are very different. For both audiences the structure, sequencing and orchestration need to be specified in minute detail: for the machine they need to be represented in standardised ways, but the amount of information in any one representation, and visual aesthetics of presentation, are not a problem; the converse is true for teachers who are very conscious of presentation aesthetics and of information overload but may need flexible, tailored representations, for example using natural language and free text.

Consideration of who or what is going to run a design raises a further question of purpose: for what purposes or situations might one choose a machine-runnable design and for what might one use a teacher. The classification of purpose here might be made in terms of pedagogical approach, teaching issue, or problem type. Purely machine runnable designs have, to date, proved successful generally in situations characterised by well defined problems where associative teaching approaches, presentation of information and a drill and practice-type activity might be appropriate[12]. So far machines have not achieved the semantic understanding and flexibility of response required by ill defined problems and social constructivist or situative learning designs in which control is passed largely to the students and the teacher acts as guide, support and facilitator, i.e. in those approaches that are generally considered the most "student centred" – the mediation of the machine, although less visible than that of the teacher, may be more constricting for the student. In other words, purely machine runnable designs cannot, so far, implement the type of designs that modern pedagogy largely promotes as desirable[13], although they do have uses in behaviourist contexts such as skills training. Equally, the teaching approach which a staff development view of practice models is likely to be promoting are those that preclude tightly specified sequences of actions on the part of the teacher or students.

We come back to the implications of this realisation in the next section. Before doing so, we briefly consider the other end of the dichotomy – practice models for inspiration. Here we are squarely in the domain of the teacher. Practice models are intended to inspire teachers to adopt effective pedagogical approaches, and support them in doing so, by promoting sharing and reuse of effective designs. As noted above, these are likely to be constructivist and situative approaches – not those in which a closely specified sequence is likely to be particularly useful. The difference between representing for inspiration and representing for runnable design for teachers in terms of the information presented is considered further in section 3 on characterising representations for sharing and reuse, where it parallels the distinction between the stages of choosing and of implementing.

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[10] Design for Learning meeting, October 2006
http://dfl.cetis.ac.uk/wiki/index.php/Shared_Resources

[11] Design for Learning meeting, October 2006, January 2007

[12] We adopt Mayes & de Freitas characterisation of pedagogic approaches into associative, congntive/constructivist and situative (Mayes & de Freitas, 2004), as amplified in the LADIE literature review (Conole et al, 2005).

[13] The TESEP model is a current example of a pedagogic model which is being used deliberately to encourage teachers to hand control of learning to their students http://extranet.lauder.ac.uk/tesep

The structure of the argument in this section, and the implications of considering purpose on the representation of learning designs, and the usefulness of practice models, is summarised in Figure 1.

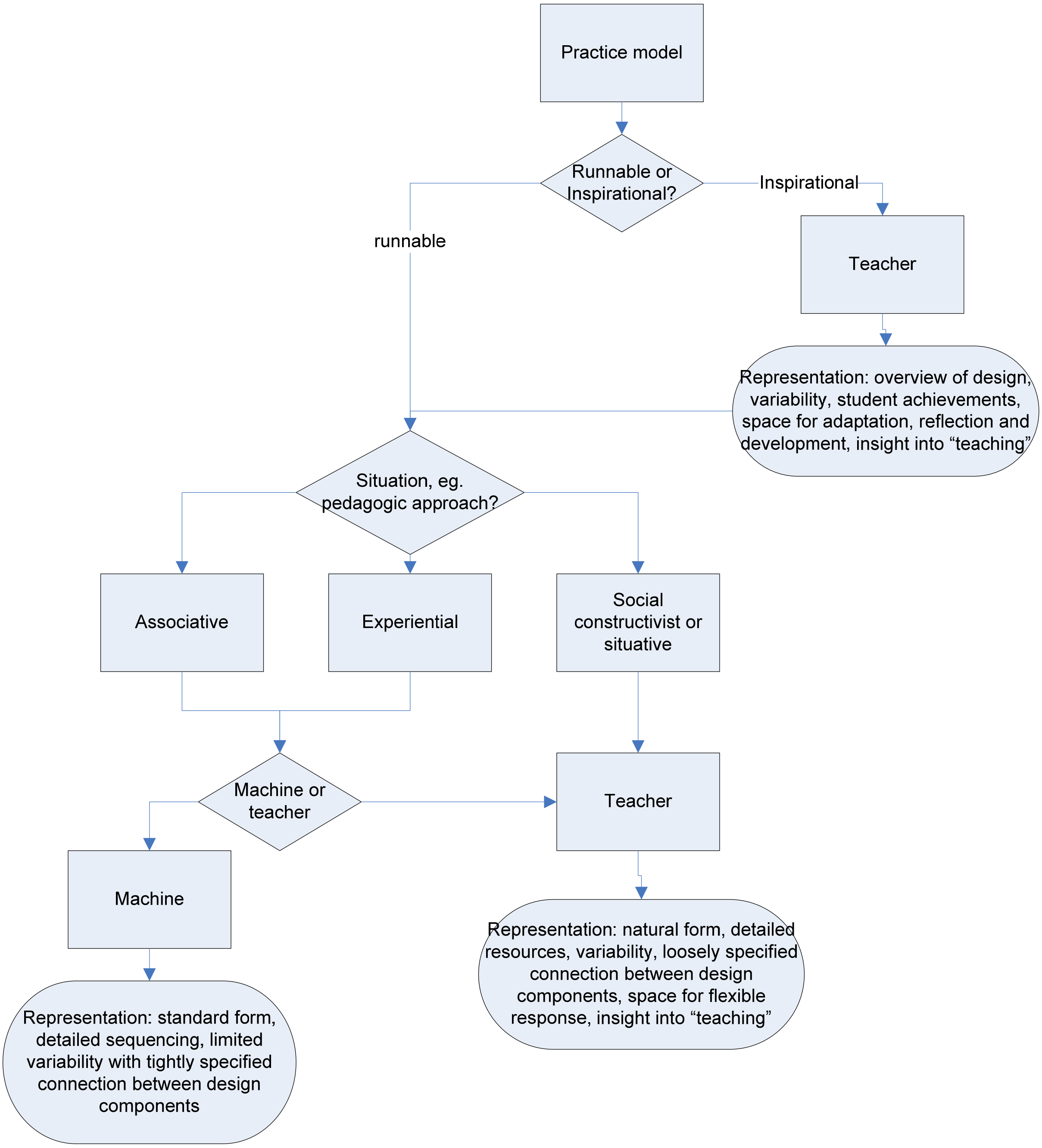

Figure 1. Figure 1. Overview of the implications of considering purpose for the representation of practice models. The purposes and situations in which teachers might want to use representations of learning designs appear to be those in which detailed specification of sequencing is not particularly useful, insight into intrinsic and tacit aspects of teaching is required.

However, even when looking at a design for inspiration, teachers need to get some insight into how they and their students would operate effectively within the confines of the design, i.e. there is a need to capture intrinsic and tacit aspects of teaching and learning. The issues at stake here may be unpicked by considering the tension between design as a product and design as a process.

2.3 *Design product vs. process*

The above discussion is, of course, overly polarised. In practice there are a whole spectrum of purposes spanning the gap between the inspirational and the runnable, the associative and the situative approaches, the teacher-implemented and the machine-implemented design. However, the central point remains: the situations in which teachers are most likely to be effective, and which practice models are likely to promote, are those in which problems are ill defined and rapid, adaptive and infinitely variable engagement between teacher, learners and resources is required.

The current metaphor of learning design is ill-equipped to deal with these situations. The metaphor is of design as a product - an engineering or architectural blueprint which specifies the components of the design and the way the components are linked. It is predicated on the assumption that the properties of both the components and the linkages are constant and stable – if the components or linkages themselves vary they do so in a manner that can be predicted by an algorithm based on their properties. In real life teaching situations this assumption breaks down. The linkages between components vary dynamically in response to a large number of contingent factors that cannot be predicted; the weather, a pertinent news item, an inspirational remark made by a student, are among the circumstances that can enable teacher and learners to make an unexpected jump to a much higher level of understanding than anticipated, or get bogged down in a morass from which they cannot extricate themselves. Even the components are seen not to have constant, specifiable, properties, when we consider that the meaning attached to them varies from individual to individual according to their pre-existing conceptual framework. This is evidenced in the education literature in debates about the distinction between intended and received learning outcomes, and conceptualised extensively in post-structuralist studies of signifying practices, representation and meaning[14]. In machine runnable learning designs it is left to the learner to manage the contingency, complexity etc of how they feel, how they manage their goals and expectations, how they cope with task demands in practice.

A more helpful approach might be to think of design for learning as two loosely coupled processes. A number of authors have made this point in the past, and have conceptualised the systems in different ways. Goodyear (2005) distinguishes between intent and action underlying his finer-grained distinction between philosophy, high level pedagogy, pedagogical strategy and pedagogical tactics. All four together comprise his pedagogical framework, but he notes that the first two are "declarative" or express intent, while the second two are "operational" or express action. However the intent and action, or declaration and operation, are inextricably linked to each other. The action might be taken by the teacher, or by a machine (computer). In traditional, face to face teaching, it is taken by the teacher when implementing the design with a class of students, i.e. the teacher takes the action in real time when teaching a lesson. The design is a preliminary plan and the teacher on the spot has up to date information and is in a position to decide on appropriate action to realise their pedagogical objectives. This active involvement in instantiating a design remains evident among e-learning practitioners in both the JISC Learning Design Tools projects: Vogel and Oliver (2006) assessing VLEs as design tools note that their practitioners "rapidly slid off into insights about the experience of *running* the designs"; Masterman (2006), evaluating generic tools, found a requirement for flexibility in plans allowing for contingency action during the lesson. Thus the teacher sees a large part of their role managing the problems of contingency and complexity, enabling their students to learn in the most effective manner.

Eraut (2004) in his discussion of informal learning in the workplace draws two related distinctions – between tacit and received knowledge, and between static plan and dynamic performance. His starting point is Tulving's (1972, 1995) theory of memory, distinguishing between episodic, semantic and procedural memory, and follows Sternberg et al (2000) in distinguishing between personal experience and received knowledge as the sources of the three types of memory. All three memory types contribute to performance, but tacit knowledge, gained from personal experience, has advantages over received knowledge when it comes to implementing procedures in rapidly changing situations because it has already been contextualised. Taught, or received knowledge, on the other hand, is based on the experiences of others, is not contextualised, is not readily available for instant use, and is more likely to be called on in static or slower situations. Thus, in a classroom situation, while taught knowledge might form the basis of Goodyear's declarative stages, planned at leisure, tacit knowledge is more likely to underlie the operational stages as the classroom situation changes rapidly.

[14] Founded on the work of Saussure (1960) and Foucault (1970). For an overview see Hall (1997)

In changing their practice the teacher is in the position of a workplace learner learning to be a competent performer (the pupils are also performers), an observation that is implied also in the cycles of interaction with resources posited by Beetham (2002), Conole and Oliver (2001), and Mayes and Fowler (Fowler and Mayes, 1999; Mayes, 2001) and discussed in Falconer et al (2006) and Littlejohn et al (2006). Eraut (2004) poses a number of questions about workplace learning that have implications for the concept of practice models:

- *To what extent is it possible to learn component knowledge and skills separately from the whole performance?*
- *If so, how authentic are the components, and is it the most effective approach?*
- *Finally, if it is possible to learn the components separately, does that constitute the major part of the learning effort, or is the integration and adaptation of those components the greater, and more time-consuming learning challenge?*

(Eraut 2004 pp10-11)

Eraut's model of performance is a dynamic one "in which a constantly changing environment provides a changing input that leads to the constant modification of plans…. A great deal of competent behaviour depends … on the correct reading of the ongoing situation so that the appropriate action can be taken….[Also] the performer is an actor who affects that environment, not always in totally predictable ways." (Eraut 2004 p12) (see Figure 2). Throughout a lesson the teacher is constantly sensing the developing situation, thinking and reassessing their plan. Where a rapid response is required, it will depend on what the teacher has learned to do without stopping to think, i.e. on tacit knowledge.

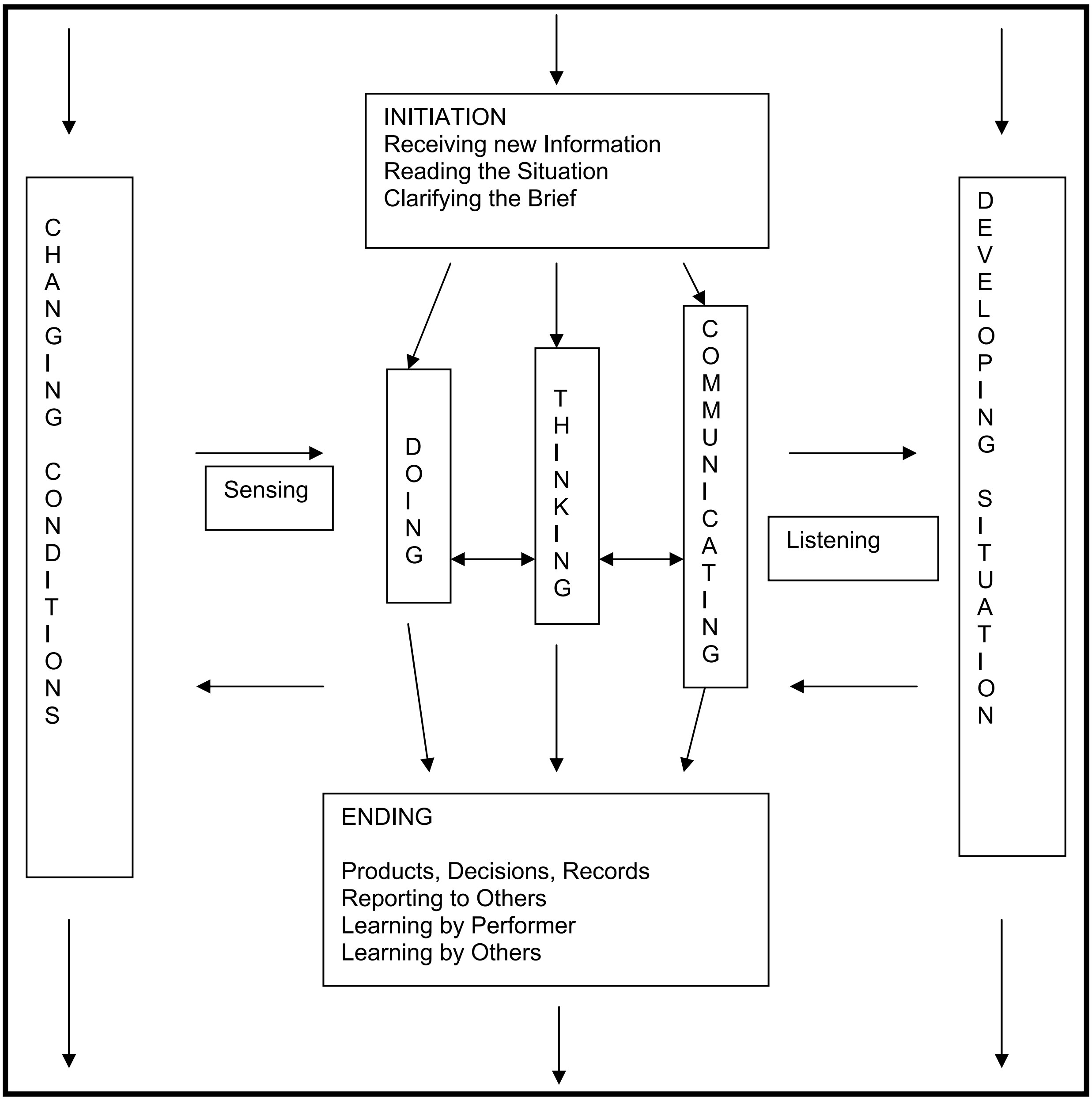

Figure 2. Figure 2. Eraut's diagram of the processes involved in a performance episode, such as a lesson. The blueprint or plan for the lesson provides only the initial brief, which is modified throughout the lesson in response to feedback and reflection on the developing conditions and situation for an effective performance. (From Eraut, 2004)

Toulmin (1999) considers the process by which individuals (in our case, teachers) develop procedures (procedural knowledge in Eraut's terms), locating them at the boundary between the individual and the collective. The newcomer to a profession, or the existing professional when changing their practice, is exposed to the shared procedures of the profession, which they internalise and make their own by repeated reinforcement through practice, i.e. the procedure is instantiated in a performance, which is a shared activity. In any enterprise (such as teaching and learning), he suggests that a theory of knowledge should establish what procedures, "are efficacious, … on what conditions, and for what practical purposes" (Toulmin 1999, p62). Teachers establish this sort of knowledge largely through dialogue: they talk about their "intent" either with more experienced teachers or internally through reflection, and they reflect during action or discuss how to respond to different class situations with colleagues. The implications for practice models are that they could be helpful as a statement of procedures that are useful, but only if they are contextualised with a statement of the conditions and purposes for which they have been found to work well, and if provision is made for dialogue around them. Furthermore, such a statement is only a first step – the teacher needs time and repeated practice to internalise and perform them.

For teachers, the situation is more complicated than Toulmin suggests since there are two very different communities with whom they share practice in collective performance: their peers, and their pupils. It is this observation that links the distinctions made by Goodyear, Eraut and Toulmin between plan and performance, received and tacit knowledge. A practice model is a statement of a procedure shared by teachers as a profession and can, to an extent, be internalised by discussion and reinforcement with other members of the profession. The recognised procedures of the profession change relatively slowly, there are relatively few time constraints and analytical thought can be employed in developing plans. However, performance of the procedure takes place in a very different community. The teacher is (generally) on their own within a community of pupils, who must assent to the procedure. The dynamics of the community vary widely from cohort to cohort, class to class and minute by minute, and thinking time is often in short supply. Instantiating the plan draws largely on tacit knowledge, which requires a detailed understanding of the context and prior experience of sharing the procedure with this type of community. The teacher, approaching a new learning design, must be able to envisage themselves teaching it, as is apparent in this comment by a Mod4L participant:

"… though the HND schedule is unfamiliar to me, I can still recognise some of the learning activities and resources and how I might structure them."

As he reads the unfamiliar schedule, he is relating it to his existing experience and imagining himself in the position of using the activities. This is possible because some aspects of the situation are familiar. At the very minimum, as preparation for a first trial experience, the teacher needs guidance on how to translate the procedure from the shared peer community to the shared classroom community. Generic practice models do not give this guidance. Detailed, richly contextualised case studies may do, if only implicitly, by surfacing the tacit knowledge on which instantiation called, and rendering aspects of the situation familiar, and this may partially explain the evident preference among teachers for this form of representation.

We are now in a better position to understand the problems of a metaphor that views learning design as the production of a blueprint. The blueprint metaphor does not recognise the developing dynamic situation. Nor, unless richly contextualised, does it surface the tacit or internalised knowledge that teachers are likely to need in meeting the situation.

The blueprint metaphor may be likened to an underground map of London where stations are cognitive entry and exit points, and lines represent the activities that lead students from point to point.(see Figure 3). The map is of a mass transport system which allows a limited degree of personalisation – alternative entry points and a (limited) number of alternative routes between points. However, following this analogy, the teacher – or the machine in a machine runnable design - is playing the role of the vehicle that conveys the students from point to point, and the map conveys no information for the teacher about how to act as a train. Nor does it provide any guidance about how to decide whether a train is actually the most appropriate vehicle, or what to do if it is not. For example, the actual distance above ground from Embankment to Charing Cross stations, above ground, in only about 200m, considerably less than the approximately 1 km from Charing Cross to Leicester Square or Embankment to Westminster that look roughly comparable on the map. On a sunny day, or during the rush hour when the underground is unpleasantly congested, or if there is a breakdown on the line, you might choose to walk from Embankment to Charing Cross for a faster, or pleasanter, journey. But the map not only does not give this type of information, it does not tell you where or how to access it, or even that it exists and is relevant. This lack is particularly important in situations that call for a flexible response – the very ones where, as we have argued, facilitation by a teacher is likely to be the most effective way of learning.

Figure 3. Figure 3. Extract from a map of the London Underground

Thus drawing an underground map is only one of the processes necessary for finding your way from A to B effectively in London. You also need much richer contextual information, updated in real time, and experience of using both the underground and its alternatives under a variety of conditions. The machine runnable learning design lacks this richness of experience and can leave the learner metaphorically stuck on the underground whereas the teacher expects to draw upon their experience to help their students find their way around. The map is coupled to other systems such as experience or the richer geographical context, and all are needed to operate effectively. As one Mod4L participant stated,

"Something that needs to be explored is what we mean by "effective in practice". In an FE context working across the curriculum I often came across different teachers who had good results by dint of entirely different approaches.... The point is effectiveness is contextualised and the learning design effective for a group of enthusiastic learners on a Tuesday morning is not necessarily effective for Friday afternoon with a different group of learners.

The underground map analogy highlights, as we stated above, that teaching and learning involve two loosely coupled processes – design as product (the blueprint for the lesson, or drawing an underground map) and design as process (instantiating the blueprint in a dynamic situation, or getting from A to B in the most effective way). The problem is that specifying how to instantiate the design requires capturing the intrinsic aspects of teaching. To elucidate this problem further, we have briefly explored two other loosely coupled systems as analogies of designing for learning which also capture certain aspects of the learning and teaching situation:

- A play script plus a troop of actors. Here the play provides the blueprint – it specifies the roles, actions and interactions of the actors, director, etc (the teacher and pupils). But there is still a huge difference between the performance put on by the Royal Shakespeare Company, and that put on by the local secondary school – the skill of acting and directing is not captured by the play script but is developed elsewhere and called upon by the demands of the script.
- A snakes and ladders board and a group of players. Here the board provides the blueprint for a

lesson, and it contains some opportunities for accelerated progress, and also some pitfalls. The situation is actually more complicated in that the snakes and ladders are not necessarily in the same place each time the game is played. What the teacher and pupils, as players, want to know is how to load the dice so that they land on ladders and avoid snakes. An effective teacher can do this and has a better than random chance of recognising and capitalising on opportunities as they present themselves.

When we consider these examples we can see why an approach to representing designing for learning, such as practice models, which provides nothing more than a blueprint, might be unpopular with teachers, and might constrain learners. It shows them a map for a lesson, but it provides no clue as to how to make their way effectively through the environment, because it is divorced from the other processes that enable an effective performance. As a Mod4L participant observed:

"the best learning design can still result in dull mechanistic teaching so the link between different designs and the scope offered for staff and student engagement may also be one worth observing."

There is little incentive for a teacher experienced in one teaching method, to change to a new practice in which they will be a novice with little indication of how they might ever become anything else. The barrier to adopting new practice that this creates is evident in Mod4L participants' calls for representations of learning designs to include,

"a comment on what went wrong and what you would do differently. Sometimes this can be more enlightening than the reporting of the good bits! It is also good to let people know that everything we try doesn't work or worked at great expense of time making it not repeatable and that it is part of creative and novel design for there to be problems"

To summarise, the production of a plan or blueprint for a lesson is only one part of successful instantiation of a lesson – the plan is one part of a process of design and instantiation which calls upon contextual, tacit and experiential knowledge, and its place within, and links to, other aspects of the process needs to be evident.

2.4 Granularity

Issues of granularity recurred frequently in Mod4L discussions. We took a broad view, considering that a learning design may be of any degree of granularity, from a course down to an individual activity. The scope of the design is determined by the learning objectives to be met: a design contains the activities required to meet a learning objective. Among Mod4L participants, the most common learning designs were probably of a lesson lasting between one and three hours, or a course module of a number of sessions.

However, a constant question in representing the learning designs was the amount of detail to include: too much and the design took too long to comprehend; too little and vital information was omitted:

"it is always hard to know where to pitch [case studies]. I have found that inevitably you leave some stuff out when writing these (space / time constraints sometimes enforce this) but it can often be difficult to get the balance of how much detail to provide (and how wrapped up that is in the context) and what to leave out."

A major issue, for sharing and reuse of designs, is the amount of time it takes a teacher to document a design, as hinted in the first quotation above, and repeated frequently in Mod4L discussions. This problem is exacerbated if teachers do not know who they are writing for – as is often the case when depositing in a repository:

learning representations entails writing for others, a sense of audience. Knowing the needs of the audience are hence important.

It is not always at all obvious to the teacher who knows what they have been doing, what detail needs clarifying for the audience who are not in the know, particularly if the audience themselves are unknown. Documenting for all conceivable audiences can seem like a daunting task, the more so the larger the design.

This issue of detail is clearly related to that of granularity: a smaller design, consisting of just one simple activity, can be more easily described and comprehended in detail, than a larger design of several complex activities. Furthermore, there is a link between the type of representation and the type of granularity it can usefully represent (see section 4 for a discussion of some examples). The way in which an institution chooses to "chunk" learning, for example into one hour sessions, is likely to impose a granularity on the design and thus on the useful representations.

However, size of the design is not the only factor affecting the required detail. Once again the coupling between the plan and context and experience is important:

"In a local environment a relatively simple narrative account is probably okay but from our first Mod4L day's work it was apparent that more information would be needed to transfer information to a wider audience."

If the plan can call upon a teacher's existing knowledge of context, or experience, then these aspects need not be spelt out. But if it is new, either in the procedures it invokes or in the context of use, then these need to be described, and their relationship to the plan made clear. This is a factor that limits the potential usefulness of learning designs for changing practice. The larger the design gets, the worse the situation is likely to become. Thus, it seems that the most effective "designs" for changing practice – because the most readily describable in sufficient detail while remaining succinct - are likely to be at the level of single activities (with associated briefing and feedback) if they use new teaching practices, or alternatively new combinations of familiar activity types.

The corresponding situation for learners is that there is no given granular size of a learning *activity* or design. For a novice, a 'single' activity such as reading critically or summarising data may need to be broken down into component steps, whereas for an expert learner these activities can just be stated or even omitted and 'taken as read'. The learning process is about internalisation of procedures such that complex activities become remembered as simple actions and can be performed with less and less conscious decision-making, eventually becoming so personal they could be described as an aspect of personal 'style' or habitus.

Furthermore, in learning to operate in a new, technological, environment, it is not always the holistic overview provided by a learning design, which can seem overwhelming, that is the most helpful, even in an electronic representation that enables drilling down to detail. As a participant at one of our talks observed, in an electronic game it is often the tricks and "cheats" that are the most useful – they can be integrated into existing practice and provide an incremental development. To provide guidance only at the granularity of learning designs may present too large a barrier to change all at once.

2.5 Communities

Thus, in documenting learning designs, knowing one's audience is vital:

"For me this has been a basic lesson of the Mod4L project - who are we writing for, for what purpose and therefore what information do we need and what format is best to achieve the intended outcome?"

Templates, such as the JISC Effective Practice planner[15] or the LADIE reference model pedagogy guide[16] can provide guidance on what to include and make the process of documentation appear less daunting, but they need to be chosen with the target audience in mind. The JISC Effective Practice planner, for example, takes a relatively high level approach and is aimed at documenting for other teachers, whereas the LADIE guide elicits considerable detail about sequencing of activities and is aimed at helping teachers communicate with technical support staff.

Thus, the question of community of use appears to affect not only the size of the unit of learning which it might be effective to try to document (see previous section), but also the granularity and even the structure of the documentation. Liz Masterman (private communication) has observed that

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[15] http://www.elearning.ac.uk/effprac/documents/casestudytemplate.doc
[16] http://www.elframework.org/refmodels/ladie/guides/LARM_Pedagogy30-03-06.doc

"Teachers may only have one to three pedagogical activities in a "typical" learning session,... but... learning design systems such as LAMS break these down by technology/tool. For example, a learning session might consist of: i) overview by teacher, ii) initial Q&A for students, iii) feedback by teacher, iv) introduction to the task (teacher), v) task execution by students, vi) submission of students' work, vii) feedback by the teacher. In LAMS this forms a sequence of at least seven "activities" because of the different tools involved. However, many teachers would probably identify a maximum of three: overview and Q&A, main task, and assessment and feedback.."

Hence, in line with the observation that what constitutes an 'activity' varies with the expertise of the learner, we could also say that it varies according to the subject of the activity (as we could predict from Activity Theory). In the case of runnable designs, it might make sense to see the system that is orchestrating the tools/services as another actor. For this actor, the sequence in which tools/services are called is the meaning of the activity. The problem is to know how (and whether) this meaning coincides with the meanings ascribed by the teacher who is 'using' the design (who differs from the designer) and of course the meanings ascribed by the learner. It is possible for a learner to carry out a sequence of learning activities 'effectively' from the perspective of the system and learn nothing.

To a certain extent, teachers can be supported in documenting for communities other than their own, provided they are given time and guidance, but if the communities are too far removed, the time overhead is too great, and intermediaries need to be used (Falconer et al 2006).

Documenting for other people is only one half of sharing and reuse, though. Community is equally important in adopting new practices from others. As noted in our discussion (above) of Eraut and Toulmin, teachers are in the position of learners as they change their practice, and the formation of a community and dialogue around a practice is essential to helping to internalise the practice so that it can be performed competently. This theoretical view is supported by Sharpe et al's (2004) finding that the most effective representations in changing practice were those around which teachers could interact with colleagues, i.e. originators and end users were part of the same, or overlapping, communities. Our experience on the Mod4L project has been similar. The need for community was stated clearly by participants at our first workshop, and we found that to a large extent, the nature of the representation that we have confronted them with has been immaterial; what has been crucial is the role of the representation as a focus for discussion within the participant community. Thus, providing support for communities may be more important in changing practice, than developing particular representation types which will, inevitably, have limited audiences, and have prescribed forms. This conclusion is bourn out by the success and amount of activity generated around the "Best Practice Models for e-Learning" Moodle site based at Staffordshire University[17].

2.6 The Way Forward

The implications for teachers and technical developers of viewing design for learning as a process, rather than production of a blueprint, need investigating. In particular, it may be more helpful to develop a domain map for learning design, than to try to develop practice models. If we take seriously the recognition that two coupled systems are involved, then a more productive way forward might be an enhanced domain map – which provides a not only a specification of the technological services available, but also an account of the pedagogical and technical couplings between them – allied to richly contextualised case studies of innovative practice, which will evidence both the design and the role of tacit and experiential knowledge and provide an indication of how expertise might develop, and supported by collaborative and community building activities and tools for teachers. This would be analogous to providing a map of London showing all transport possibilities, together with accounts and peer group dialogue about how people have used the systems under various circumstances and to achieve certain aims. This, then, would enable flexible response and the prospect of developing expertise and effective teaching in the new practice.

This is not to say that Practice Models as conceived at the outset of the Mod4L project have no value. They do, but it seems unlikely that it will be in changing teaching practice. One area in which they may have considerable value is in communicating the needs and expertise of teachers to technical

[17] http://crusldi1.staffs.ac.uk/moodle/course/info.php?id=9

developers. The use cases of learning activities developed on the LADIE project are a type of practice model aimed at a technical audience and provide an example of such a use[18]. Here they were used as a stage in the development of a learning activity domain map or reference model along the lines that we are suggesting. Parts 5 and 6 of this report look in more detail at two further types of representation that may be important in communicating between teachers and technical developers, taxonomies and temporal sequences.

The Learning Activity Design in Education reference model[19] and other JISC eFramework projects[20] have gone some way towards providing a domain map, but there is still a lot to be done. In particular:

- LADIE focused on learning activities, which are defined more narrowly than learning designs;
- The reference model and domain map projects all took their own individual approaches to what a domain map would look like and hence they do not cohere with one another even where the domains touch;.
- The projects focused on technical constraints and requirements (or couplings). Effective pedagogical practice involves coupling different elements of the LD domain, and in different ways (i.e. dynamically, conditionally, and often bi-directionally);
- The projects did not succeed in mapping the entire territory assigned to them – they served, rather, to highlight where there are still gaps.

Thus we see the way forward as:

- To bring the existing domain map and reference model projects together into a coherent whole and explores what else needs to be mapped to provide a domain map for designing for learning;
- To surveys the couplings between technology type and pedagogic use begun by Beetham (2005), the LADIE gap analysis[21] and pedagogy guide[22]; and the AUTC project (AUTC, 2003). See also section 6.3.2.
- To continue the documentation of contextualised case studies of good practice begun in the Effective Practice guides;
- To provide ongoing support – and time - for teachers to form sustainable communities around developing practice.

3 Characterising the representation of learning designs

In the rest of this report we turn away from the issue of making generic designs of use to practitioners, and consider the representation of learning design for practitioners more generally.

3.1 Frameworks for characterisation

Learning designs are one type of resource for teachers, and, as such, the analysis of frameworks for characterising effective e-learning resources discussed in Littlejohn et al (2006) is applicable. The paper discusses various frameworks including:

- Stages of a learning cycle
- Degree of embeddedness of information content (digital asset, information object, learning activity, learning design)
- Representation, medium and format
- Mode of use based on Laurillard's conversational model (narrative, communicative, interactive, adaptive, productive)
- Degree of adaptation

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[18] http://www.elframework.org/refmodels/ladie/ouputs/usecases/
[19] http://www.elframework.org/refmodels/ladie/guides/
[20] http://www.elframework.org/refmodels
[21] http://www.elframework.org/refmodels/ladie/guides/LADiE%20Gap%20Analysis.doc
[22] http://www.elframework.org/refmodels/ladie/guides/LARM_Pedagogy30-03-06.doc

Based on the outcomes of the JISC-funded study of "The Effectiveness of Resources, 16 Tools and Support Services used by Tutors in Designing and Delivering E-Learning Activities'[23], Littlejohn et al identify 12 usability characteristics of effective resources, and map them against five factors important in designing effective resources identified by Sharpe (2005) and the stage of use and degree of adaptation classifications (see Figure 4)

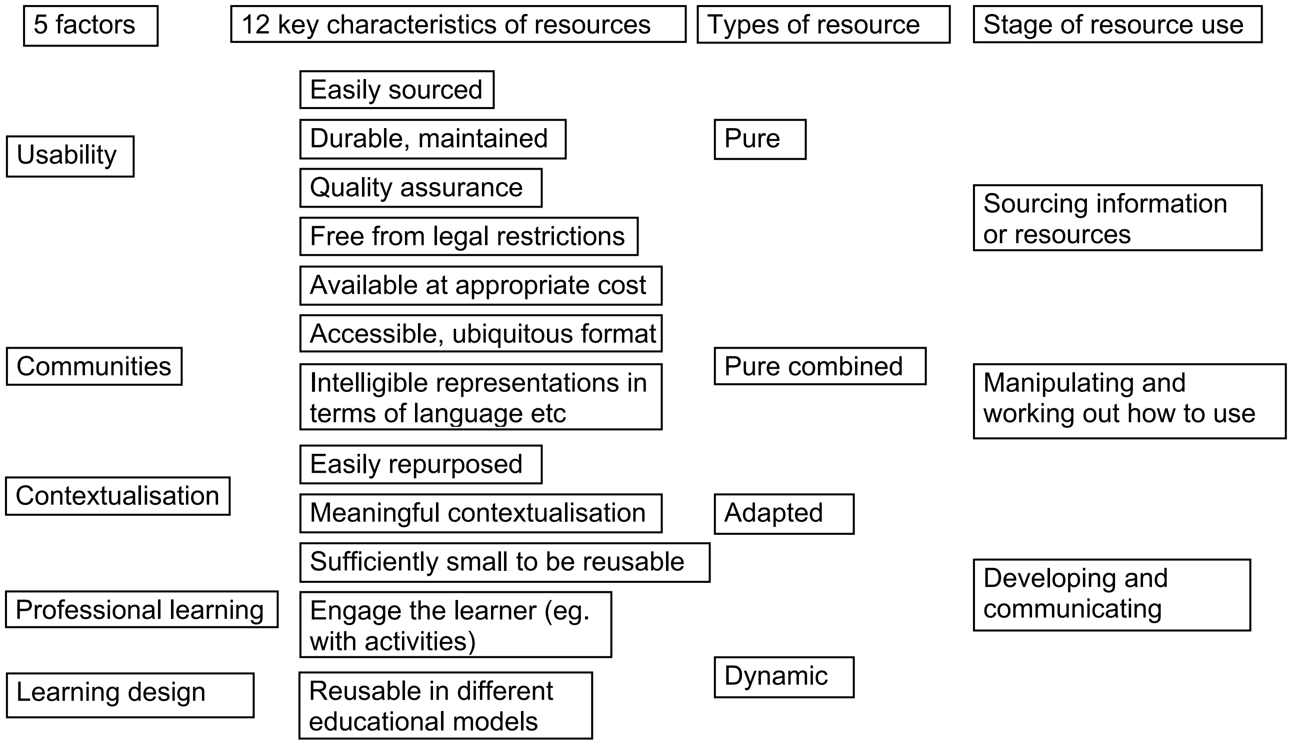

Figure 4. Figure 4. Factors likely to influence positively the use of a resource (from Littlejohn et al (2006).)

These characteristics and factors apply equally to representation of learning designs and practice models. They impact on the decisions made in documenting a design at the five layers of communication identified by Burn (forthcoming) and Kress and van Leeuwen (2001):

1. **Knowledge** - of what is to be communicated (e.g. an innovative teaching practice). In general the learning designs contributed, or recommended, by Mod4L participants concentrated on factual information and descriptions of processes. Pedagogical knowledge or model is also often included, either in a heading, or gloss or reflection on the approach. One participant included his approach explicitly in a field at the head of each learning design ((Figure 5).
2. **Design** - choice of mode of representation (e.g. language, visual, audio). All learning designs used, or recommended by Mod4L participants used natural language to some extent, and some used it almost entirely in the form of narrative accounts. One participant was emphatic that prose (as opposed to bullet point notes) was necessary for conveying information to others.

"Simple sentence structures explaining what I need to do. In many of the designs seen so far there is a noticeable absence of prose and a preferment for bullet-point style comments and keywords. Often these are just memory cues and subsequently mean nothing to anyone but to the person who wrote them"

[23] http://www.jisc.ac.uk/uploaded_documents/Final%20report%20(final).doc

group: Advanced English through I.T. **topic:** Reading graphs and tabulated info **date:** week 16 **length of session:** 3 hours

TUTOR questioning: **ECHO** so you think **SUGGEST** you could try **SCAFFOLD** have you ever noticed **ELABORATE** say a bit more **SPECULATE** what would happen if **CLARIFY** I think what you mean **W5H**

aims:	learning outcomes:
Understand metric system by measuring each other's body parts and entering information into Excel	Read tabulated information and correctly answer all of questions **Rt/E2.3a** Recognise questions of the wh- type **Lr/E2.5b** Create 5 compound and comparative sentences using 'than' **Rs/E21b**

timing:	content:	teaching/learning/assessment activities	visual	audio	practical	resources / teaching materials
15 mins	Introductions	Introduce learning outcomes for lesson and recap on previous week.	*	*		tutor input/discussion worksheet
30 mins	Discuss metric and imperial measurements	Whole group: elicit existing understanding of metric measurements and discuss imperial system used in UK. Model how to measure parts of body. Small group work: measure each other and feedback back to class. Whole group work: feedback answers to all and prepare for individual work. Discuss simple and compound sentences using conjunctions – explain 'than.'	*	*	*	pen and paper / whiteboard / worksheet / discussion
60 mins	Enter findings into Excel	Individual work: enter totals into Excel and create column-chart. Watch tutorial video if required. Create table in Word and answer wh- questions related to graphs. Create 5 compound and comparative sentences using 'than' **Rs/E21b**	*		*	computer / watch video if needed
15 mins	Teabreak					
30 mins	Discuss findings	Display student's charts on whiteboard and use direct questioning. Recognise questions of the wh- type and answer direct questions about findings **Lr/E2.5b**	*	*		projector / discussion
15 mins	Plenary	Discuss outcomes. Complete diary. Anticipate next lesson.		*	*	diary / discussion /whiteboard

Evaluation	Notes on individuals, groups, differentiation
In this session we have addressed: ☐ health and safety ☐ ICT ☐ equal opportunities ☐ study skills ☐ portfolio building ☐ life/social skills	Forward planning

Figure 5. Figure 5. Example of a personal template containing a field for the pedagogic model (echo, suggest, scaffold, elaborate, speculate, clarify, W5H) and tags for learning outcomes. It also shows the features of organisation and orientation discussed by Lemke (2002) and, unusually, space for differentiation and self evaluation (see section 3.2) (reproduced courtesy of Stephen Woulds)

One participant used video (a combination of visual, audio and language) while another used concept maps (a combination of visual and language). Metadata, in the form of tags for learning outcomes or external benchmarks were occasionally used. For further details see the Mod4L interim report (Falconer & Littlejohn, 2006)

3. **Production** - choice of medium (e.g. paper, web site). Nearly all the learning designs submitted or recommended by Mod4L participants were paper-based or contained on a single web page. The exceptions were a video created in MS Producer, and a computer-based concept map with drill-down facilities. One participant suggested a real-time instantiation using a fishbowl technique as the means of production (as described in Prideaux et al (2001)), although noting that this was difficult to distribute in bulk.
4. **Distribution** - choice of technology for distribution to audience (e.g. print, podcast, web site). Text-based accounts are easy to disseminate either in print or on a web site. The video and concept maps, which comprised large numbers of linked files were more problematic and proved impossible to upload to the project wiki, although they could be distributed on CD or data stick.
5. **Interpretation** by audience

Our use of the term "representation" on the Mod4L project is encompassed by the design, production and distribution layers as the teacher documenting their practice embeds the meaning they intend to convey in the representation. The way they do this has consequences for the ability of the audience to interpret the representation, and has three dimensions according to Lemke (2002):

1. **Presentational** (e.g. the information content, aims and objectives, evaluation). We discuss this in section 3.2.
2. **Orientational** (e.g. cues that allow the audience to orient themselves to the practice represented, for example by relating it to familiar experience or surfacing tacit knowledge). This aspect is often under-developed in representations of learning designs, and particularly in the generic forms of practice models. Of the text-based learning designs submitted by Mod4L participants even the most schematic had some orientation cues such as external resources used or benchmarks met (see, for example, Figure 6). A second aspect of orientation is the cues that tell the audience what their role is in the learning design. For example, the representation in Figure 5 contains a number of instructions ("explain", "display students' work") that make clear that this is a representation for the teacher and that it is their responsibility to lead the lesson. The more schematic representation in Figure 6, being just a list of topics covered and links to resources, contains no such cues and might be equally applicable to teacher, student, or programme leader. One problem for teachers with the AUTC temporal sequence method of representation (see sections 4. and 5) is that the student role forms the central focus, and Mod4L participants found it difficult to see where they, as teachers, fitted in.
3. **Organisational** (e.g. links and patterns that ensure coherence of the representation as a whole – this is particularly important in a multi-modal representation of a learning design such as those proposed by the pedagogic planner projects[24] or a hyperlinked representation with drill down features). In the majority of text-based designs used by Mod4L participants, headings, standard templates, matrix formats have been used to organise the information and ensure coherence (see, for example, Figures 5 & 6)

PROJECT MANAGEMENT MODULE
EXTRACT FROM LESSON SCHEDULE
2005/06

Session No	Learning Outcome Group, Topics	Project Management Textbook
1	Module Introduction Administration, Aims and Objectives Teaching and Learning (Session structure, assessment, resources, registration in ATHENS, BSI, tutor support, textbooks, software, on-line discussion tool.	

[24] http://phoebe-project.conted.ox.ac.uk/cgi-bin/trac.cgi ; http://www.wle.org.uk/d4l/

	PM Principles Definitions and Overview Types of project, Context	Chapter 1 Introduction Chapter 2 History Chapter 1 (PM Associations, Environment, BoK, Role of PM)
2	PM Principles Projects, Programmes and Portfolios Project Lifecycle – examples including PRINCE2, CMM, CMMI, Unified process Time, Cost and Quality (PM Triangle)	Chapter 1.3 Chapter 3 Chapter 2.9
3	PM Principles Project Selection, Business Case, Stakeholder Identification, Analysis of Needs Success Criteria, Success Factors, Performance Indicators The Project Plan	Chapter 4 (Feasibility Study – ignore Value Management and Cost/Benefit Analysis) Chapter 5 (Top-level treatment only)
4	Business Organisation Structures Functional and Matrix Organisations PM Principles Creation and use of WBS, OBS, CBS Tools for Project Management Network Methods, Critical Path Analysis, PERT	Chapter 2 – History Chapter 20 Chapters 7, 9 Chapter 2 – History Chapters 10, 11 Appendices 1,2
13	Revision Practice Tests	Project Management – Planning and Control Techniques

Figure 6. Figure 6. A very schematic representation of a learning design, intended for the author's own use. Even in this context the author uses a template and headings to organise the information, and reference to the external structure (session number) and textbook to orientate the design (reproduced courtesy of Angela Benzies).

Organisational coherence was also very important to Mod4L participants at the higher level of the repository. A potential problem with richly contextualised case studies is the time taken to read and digest them – especially if they subsequently turn out not to be suitable for the purpose in mind. Our Mod4L participants were emphatic that case studies should have a brief overview to allow rapid diagnosis of likely suitability, and that they should be in a standard format which again aided rapid discovery of required information. Most also seemed to prefer a clear prose description – although a diagram or concept map might provide an overview of structural relationships. One participant recommended the ReadWriteThink website:

"An effective example of this writing for others in clear prose and with recognisable structure is the lesson representations of http://www.readwritethink.org/index.asp. Most lessons have a similar structure/sequence of activities. These I think are included below in a linear fashion (top to bottom) with descriptive writing explaining what each sequence step might have in it.

The brief overview lets you quickly identify if this particular lesson is of use to you without having to waste time reading extensive notes before realising it isn't of use to you. The section on theory to practice outlines the pedagogical justifications. Each section has links to resources. There is also a printer-friendly icon so that I can read the learning representation off line.

- *Overview*
- *From Theory to Practice*
- *Student Objectives*
- *Instructional Plan*
- *Extensions*
- *Student Assessment/Reflections"*

An alternative characterisation of learning designs, by pedagogic model, is often suggested and, indeed, was one of the original aims of the Mod4L project. However, an issue for such a characterisation is that most of the learning designs combine a number of different models, either explicitly or implicitly. This finding echoes that of the LADIE project (see use cases[25]) and the Phoebe pedagogic planner (Masterman, private communication). This sometimes happens for sound pedagogic reasons (such as providing for differentiation), but sometimes because of external constraints. One of our practitioners commented explicitly that she would like to be more constructivist, but was constrained by SQA (Scottish Qualifications Authority) requirements to teach to highly specified outcomes. She felt that her design (Figure 20) was "instructivist with an overlay of constructivist activities".

It is possible, however, to derive generic designs corresponding to different pedagogic models, from examining a number of different designs. In this way five generic designs, mapped against pedagogic approach, have been derived from commonalities between Mod4L and LADIE learning designs. Similarly Oliver et al (2002) have distinguished four different basic designs for constructivist learning, while Beetham (2005) has noted that teachers do not tend to think in terms of formal pedagogic models and has produced eight generic designs corresponding to different priorities. These generic designs are reproduced in Appendix 2 (section 8.2).

3.2 Presentation of learning designs for sharing and reuse – information requirements

To establish the information requirements teachers have of learning designs for sharing and reuse (i.e. what needs to be included in the presentational dimension of the representation) we ran an activity at the JISC Pedagogy Experts Meeting in Birmingham in October 2006, and again at our second Mod4L practitioner workshop in Glasgow in November 2006.

We described four stages of sharing and reuse:

- Browsing/searching (a repository)
- Choosing a design
- Developing/editing a design
- Instantiating a design

A fifth stage: reflecting/reviewing and feeding back to repository is not covered explicitly, but can be inferred from the above four stages, and depend on the function/structure of the repository.

Practitioners, working in groups, were given four large sheets of paper (one for each stage), and a pad of post-it notes, and asked to use the post-its to record what information they thought they would need at each stage. The results were transcribed and are shown in Appendix 3 (section 8.3). The information requirements from the first workshop were grouped into themes. A second person grouped the information requirements from the second workshop, the differences between groupings discussed, and the first outputs mapped onto the second themes, adapting them where necessary, to produce a final, refined set of themes:

- Instantiation
- Adaptability
- Pedagogy
- Discipline
- Environment
- Audience
- Quality
- Operational Factors

Although we did not request it, the groups also volunteered information about the relative importance of usability characteristics at various stages, and this has been included as a separate theme in the following tables and figures, This is not to imply, however, that these are information requirements.

The themes, and the different types of information requested within them, along with the number of requests, are shown in Table 1. The results are summarised visually in Figure 7

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[25] http://www.elframework.org/refmodels/ladie/ouputs/usecases/

Theme, and information requested within theme	Number of requests for each type of information. Number of groups = 11			
	Browsing	**Choosing**	**Developing**	**Implementing**
Instantiation (I)				
content package				1
design				1
timing				2
sequence				1
structure		1	1	1
teacher reflection		3	4	3
case studies	1	1	2	
tips			2	1
tutor notes				1
Instantiation Totals	**1**	**5**	**9**	**11**
Adaptability (A)				
alternatives (approaches, activities, resources, tools)	1	3	4	2
back-up				1
further information			1	
research			1	
thesaurus			1	
granularity	1	1		
time flexibility				1
remedial activities				1
Adaptability Totals	**2**	**4**	**7**	**5**
Pedagogy (P)				
assessment	2	2	1	2
activities	6	3		1
approach	7	3	1	
purpose	1	1		
needs/issue	3	1	1	
process	1			
locus of control		1		
Pedagogy Totals	**20**	**11**	**3**	**3**
Discipline (D)				
content	2		2	2
learning outcomes	5	4	1	2
subject	6	2		
discipline	4			
Discipline Totals	**17**	**6**	**3**	**4**
Environment (E)				

infrastructure/resources		3	1	5
session length	1	1	1	1
position in course			1	
tool/technology	3		1	
physical environment	2			1
institutional context	1	1		
delivery mode		1	1	
learning environment				1
resource status				1
Environment Totals	**7**	**6**	**5**	**9**
Audience (Au)				
group size	2	1	3	1
student ability		1		
level	8	2		1
learner characteristics	4			
accessibility	1		2	
Audience Totals	**15**	**4**	**5**	**2**
Quality (Q)				
student feedback	1	3	5	1
student output		6	2	
peer review	5	9	2	
summary		1		
author	5	3		
evaluation framework				2
number of downloads	1	1		
institutional origin	2			
date	1	1		
innovative		3		
Quality Totals	**15**	**27**	**9**	**3**
Operational Factors (OF)				
time/effort		3	2	2
barriers/enablers		1	1	
support		2	2	2
copyright	1	3	2	
availability		1	1	
contact with previous users		2		
cost	1			1
teacher experience/skills		1		1
Operational Factors Totals	**2**	**13**	**8**	**6**
Usability Characteristics (UC) (note, these are not information requirements)				
easy to read and understand	1	4	2	
inspiration		1	1	

format		1	3	
accessible			2	
disagregable			3	
granularity		1		
innovative		1		
easy to develop				
medium	1		1	
culture		1		
Usability Characteristic Totals	**2**	**9**	**12**	**0**

Table 1. Information requirements for representations of learning designs at four stages of sharing and reuse, grouped under 8 themes, plus usability characteristics.

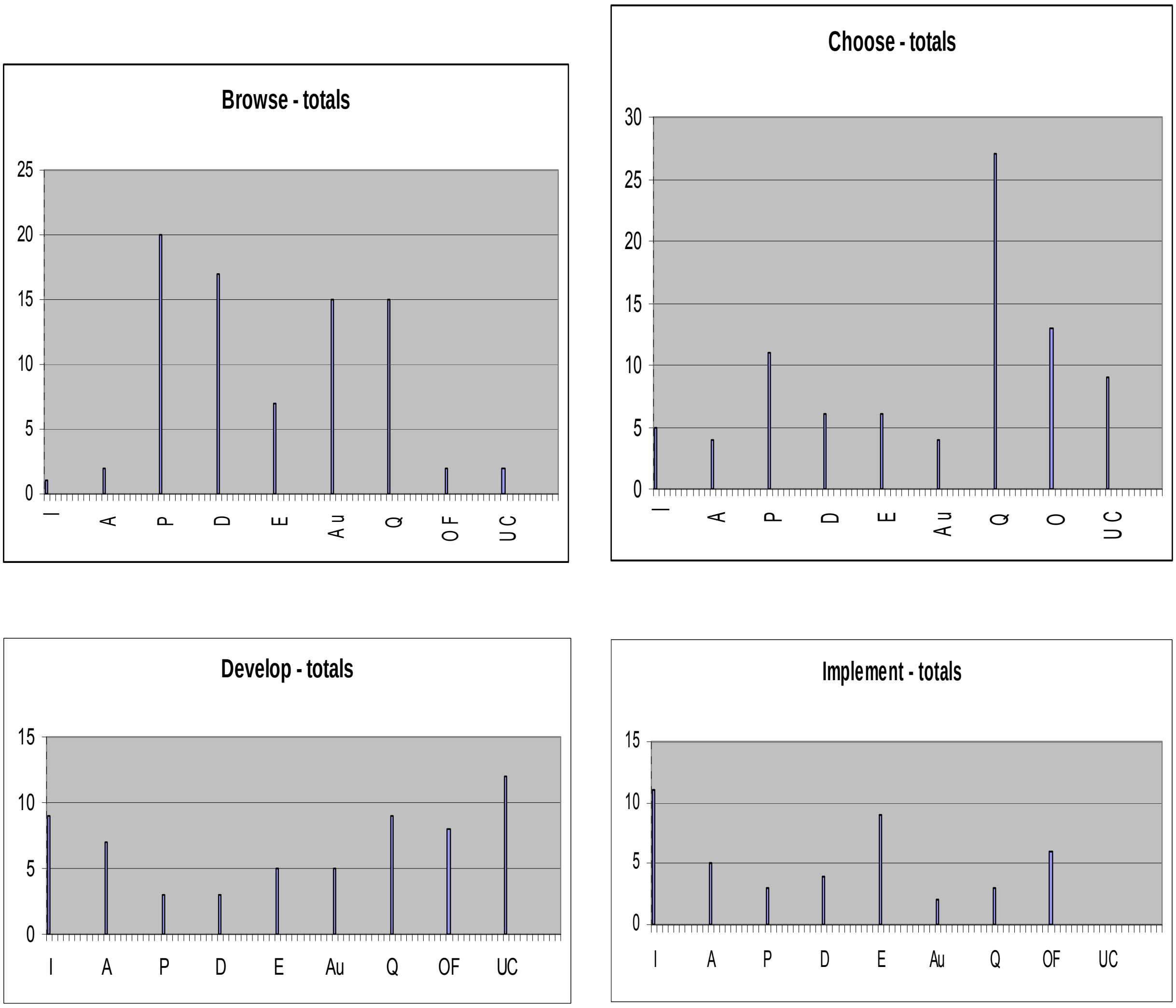

Figure 7. Figure 7. Information requirements of representations of learning designs at four stages of sharing and reuse, derived from data in Appendix 4. Abbreviations: I = instantiation; A = adaptability; P = pedagogy; D = discipline; E = environment; Au = audience; Q = quality; OF = operational factors; UC = usability characteristics (not actually an information requirement, but included here to show the stages at which it they become most important).

While little reliance should be put on the actual numbers involved and shown in Figure 7, the differences in the shape of the requirements at each stage is marked and substantiates the point that multiple representations of a learning design are necessary to support different purposes.

The data suggests that a teacher looking for a reusable learning design is likely to browse or search in categories relating to discipline (e.g. history, French Revolution), pedagogy (e.g. problem based learning, acquire knowledge), audience (e.g. dyslexic, HNC), or quality (e.g. author, peer review rating). Once they have found a design that fits their main priority, they will be seeking evaluative and quality information and information about the operational factors that will enable them to judge whether it is feasible to run the design in their own situation. Pedagogical and disciplinary information have become comparatively less important at this stage. They become even less so once the teacher has chosen a design to develop. In the development stage information and suggestions for possible variations, and evaluative reflections on what might be improved become important, as do details of the original instantiation. The usability of the representation in terms of how easy it is to disaggregate and edit is also significant. When it comes to implementing the developed design, teachers need details of how it is to be instantiated, e.g. sequencing and timings of activities, and aspects of the environment and resources which are called upon during the design. Throughout all four stages environment has a fairly steady presence, suggesting that teachers hold the institutional context in mind throughout all stages of sharing and reuse.

These conclusions are supported by Beetham's research into preferred representations of practice for the Reusable Educational Software Library (reported in Beetham et al, 2001). Statistically significant differences were found between the kinds of resource practitioners wanted for 'informing' themselves .e. inspirational designs compared with 'adapting' and 'adopting' i.e. runnable designs.

4 Evaluation of Representation Types

One of the functions of the Mod4L wiki was to discuss the use and usability of nine different ways of representing learning designs:

- Case studies
- Video case studies
- Controlled vocabularies
- Matrices/templates
- Patterns
- Concept maps
- Temporal sequences
- Flow diagrams
- LAMS

These types were chosen either because they appeared, to the project team at the outset of the project, promising ways of representing practice models to teachers, or because they were suggested by Mod4L participants in the first workshop. The "types" do not all have the same status – for example, LAMS could be viewed as one particular type of flow diagram, as could concept maps.

In the next sections the suitability of the representation types for supporting sharing and reuse among teachers is evaluated, both drawing on evidence from the wiki, and against their ability to convey the information required by practitioners at the four stages of sharing and reuse, and hence their ability to support these stages. Later, in sections 5 & 6, the potential use of sequencing representations and taxonomies for meeting the dual needs of teachers and technical developers is considered in more detail.

4.1 Case studies

4.1.1 Description

A case study is any account of practice that is designed to support learning about practice. Typically it will take the form of a written narrative, though the narrative may have been constructed according to a provided template or a series of questions/prompts.

A case study may be an aid to the person who writes it – typically also the person involved in the practice described – as a tool for reflection and self- or peer-evaluation. It may also be useful to other practitioners working in a similar context. For example, the developer of case study database for teachers of Engineering writes '*we're interested in transferring practice from one institution to another (or occasionally inhibiting the adoption of bad practice). More often than not, we're describing* *something which happens in one area of engineering (say Civil Engineering) in the hope that it might be used in others (Mechanical, for example).'* Case studies can also support the broader learning that takes place in research and development projects such as Mod4L, particularly if they form a body of studies from which general lessons or models can be drawn.

Features that enable a case study to support learning about practice include:

- A clear account of *how* something was done, including pedagogical and technical details
- A clear account of *why* it was done, i.e. the problem or opportunity addressed, and the rationale for this approach
- A clear account of the *context,* so readers can infer whether a similar approach might work in their own context, e.g. details of the learners, the learning environment, and where relevant the wider institutional environment.
- Some discussion of the *outcomes*, even if there is no formal evaluation: What really happened? How was it for the learners? For the practitioner(s)?
- A case study may also offer a more general analysis of *lessons learned* or advice to other practitioners, though some readers will prefer to draw their own conclusions.

A case study always describes a specific example of practice. It may however be intended as an example of a generic model, such as 'problem-based' or 'constructivist' learning, and researchers/developers may extrapolate generic models from a body of case study evidence or use such models as a means of classification. Case study accounts can be provided at almost any level of detail, and with different focal points or perspectives (e.g. learner, teacher, organisation). This allows them to be used for a wide range of purposes, and to offer a rich picture of the situations in which e-learning takes place.

However, the same features make case studies difficult to generalise from and to classify, making them less useful to those who need to manage the complexity and variability of situations (e.g. developers of learning systems and materials, some kinds of researcher). Many projects looking to generalise from a body of case study evidence have therefore developed *templates* to ensure consistency and sufficiency in the descriptions that compose them. Some examples are discussed in the following section.

Although practitioners in the Mod4L study welcomed the standardisation of data that a template would allow, there are problems with this approach. A template necessarily dictates which features of a learning situation will be recorded, and this is bound to be biased towards a particular set of interests. Case study providers may not share these interests, or may find the template difficult to use or overly constraining. One contributor to this study argued that it was precisely the lack of complete and standardised information that made case studies powerful tools for learning. Having used a case study template to elicit detailed background information from contributors, another expert had found that *'too much specific detail about the course in which a resource/technique was used can reinforce the feeling that such an approach is "not suited to how/what we teach here''* i.e. can inhibit the transference of practice that case studies are intended to support. Whatever the rationale, except where templates are being used by a small team to collect standardised evidence for a specific project or purpose, they do not seem to have been achieved widespread use or success. We are certainly a long way from agreeing *which* template provides the best format for the collection of case study evidence.

As the foregoing suggests, different strategies for collecting case studies produce different types of account. Contributors may provide case studies as simple narrative text, with the purpose of recording their practice for professional development or perhaps a desire to learn from and contribute to a shared body of knowledge about practice. They may use prompts or sub-headings to help structure their text. They may write into a structured pro-forma with clear guidance as to how each section should be completed. Or case studies may be written by a researcher/developer, for example following an interview or observation. This will make for a more standardised set of accounts. Free-form case studies may be accompanied by a formally structured metadata record, which again may be completed by the provider/practitioner or by a more expert researcher or librarian.

A template, whether a metadata schema or a format for writing the actual case study account, standardises the kind of information that is included. A restricted vocabulary or very restrictive guidance notes, attached to one or more fields of the template/schema, provides a further level of standardisation which can be used to aid classification and browsing/searching. See the sections on matrices (4.4) and on vocabularies (4.3, & 6) for further discussion.

4.1.2 Examples

Two examples of case study collections will be considered, both based on common templates for recording the case study data.

The **Otis** case study collection[26] was regarded in a positive light by participants in the Mod4L study. A fairly detailed template was used[27]. The 65 case studies were selected from 80 submitted by participants at a workshop: therefore contributors shared a common understanding of the purpose of the case studies and had a chance to explore the template and model examples before providing their own. Following submission, case studies were classified for browsing by author name, theme and category. The 'search' tool offered on the Otis home page does not seem to have been implemented.

Participants in the Mod4L discussion liked the different browse options and the consistency of format afforded by the use of the template: '*so after reading a couple you knew where to look in order to answer (some of) your questions (e.g. what level / subject / pedagogy was this using*'. The template also encouraged brevity, though one person commented that she would have appreciated a more detailed narrative that could be accessed separately.

The **JISC e-Learning programme** has collected a number of case studies[28] using three versions of a common template[29]. Unlike the Otis case studies these were collected by small teams of researchers. An evaluation of the *Effective Practice* guide and CD-ROM, in which the original set of case studies were distributed, found that they were rated as the most valuable aspect of the publication. However, a significant minority of respondents also rated the case studies as the *least* valuable aspect, citing issues such as lack of relevance to the user's specific context (McNaught 2005).

At present the case studies are not available for browsing or searching but they have been classified according to learning outcome, broadly defined. The template used to collect these case studies has since been adapted for use by a number of other JISC projects, Techdis, the HE Subject Centres, and several HE CETLs, and mapped to a number of international standards such as IMS LD. Its adaptability has allowed this template to be adopted beyond its original context of development, but of course also compromises its capacity to be used for cross-searching and for classification and standardisation of case study records.

A criticism of this template is that it does not encourage proper evaluation, providing only for a general entry with brief notes as to how evaluation may be carried out. This makes it less daunting to practitioners but less credible to researchers and developers. A participant commented on this template (though it may be taken as a comment on the utility of templates in general): *'Most lecturers are able to describe what they or their students do in way which is intelligible to other lecturers in similar subjects without trying to structure it in this way. In fact we have a general (slight) concern that producing case studies to this template is going to be more time consuming and more difficult for us and our informants than the approach we have now*.' A key phrase here is 'in similar subjects'. If the purpose of a template is to standardise the information required across more than one community of practice or interest, it may expect to encounter resistance from users. But a template that works well for just a small group of practitioners does not help designers/developers to manage the variation that exists in learning requirements or in teaching practice.

Several HE Subject Centres have collected case studies to a common format, including the Engineering and Geography subject centres. The HE Academy has its own case study template[30], as does Learning Lite[31]. A template very similar to the JISC e-Learning template was used by the LADIE

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[26] http://otis.scotcit.ac.uk/

[27] see http://otis.scotcit.ac.uk/casestudy/example.htm

[28] currently 26 - see http://www.jisc.ac.uk/whatwedo/programmes/elearning_pedagogy/elp_casestudies.aspx; http://www.jisc.ac.uk/whatwedo/programmes/elearning_pedagogy/elp_innov_casestudies.aspx and http://www.jisc.ac.uk/whatwedo/programmes/elearning_innovation/eli_casestudies.aspx

[29] see http://www.jisc.ac.uk/uploaded_documents/CS(App1)_Quest(ARam).doc for an example phrased as an interview schedule

[30] see http://www.heacademy.ac.uk/resources.asp?process=filter_fields&section=generic&type=some&id=4

[31] see http://www.e-learningcentre.co.uk/eclipse/Resources/acadcasestudies.htm

project to collect examples of learning activity sequences[32], which were then used to define a series of use cases. This demonstrates that the use of templates to define key data elements can be effective across different types of representation and is not limited to case studies. For example, the matrices exemplified in Section 4.4 below are similar to templates for collecting case study data but are intended to stand as sufficient representations in their own right. Templates may be a useful way of introducing controlled vocabularies to narrative representational forms, and so of typologising elements of the learning situation they describe (see section 6): they can also act (formally or informally) as metadata records.

4.1.3 Utility of representation

Sharpe et al (forthcoming 2007) have identified features of resources such as case studies that make them particularly useful for learning about practice. Adapting their findings, we can expect a *useful* case study to:

- have a clearly defined user base, to which they are accessible, available and useful
- have a clear rationale and take into account users' language, situations and concerns
- be commissioned, provided, developed, used and circulated by users
- be part of a large enough body of case studies to make searching productive for the majority of users
- be capable of being understood and applied outside of its original context
- be focused on educational approach and the outcomes for learners
- promote reflection and self-evaluation (on the part of both contributors and users)

Participants in the Mod4L wiki expressed similar requirements. They wanted case studies to include analysis and evaluation as well as description: '*what went wrong and what you would do differently'; 'what was learnt'.* One wrote a wish-list as follows:

- *relevance, i.e. some common ground between practitioner and case study, such as subject area, or methodology (online/blended)*
- *easy to find key information quickly*
- *clear description of what was done and the results*
- *thoughtful conclusions that inspire consideration and experimentation*
- *not too long*
- *if comparing several case studies, then a standard format (at least for key information) is helpful*
- *good abstract or classification system to enable efficient filtering and finding of relevant case studies.*

In both these lists of desirable features there is a tension between standardisation (allowing classification, searching/browsing, ease of information recovery and comparability), and the deep learning that comes with 'reflection, 'self-evaluation' and 'thoughtful conclusions' about a specific context. There is an additional tension between both of these consumer requirements and the constraints operating on the providers of case studies. A participant highlighted that many providers feel '*confusion about format or how to communicate the main ideas effectively, or maybe just shortage of time'***.**

It is apparent that case studies have the greatest utility if providers and users belong to the same community, with parallel concerns. However, any web search for e-learning case studies will throw up a preponderance of 'organisational' over 'pedagogical' materials. This may be precisely because the practitioners who are implementing e-learning lack the time to write up their practice in a way that is useful to others (i.e. standardised and/or carefully analysed). Those with time bought out to disseminate accounts of practice are often in organisational roles and may be closer to organisational issues than to the pedagogical concerns of practitioners. This is a further barrier to effective representation of learning and teaching at a level detailed enough to support design decisions and design systems.

Single case studies or a small number (as in both the Otis and JISC examples) have limited utility as it

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[32] see http://www.elframework.org/refmodels/ladie/ouputs/workshop/

is highly unlikely any case will match the enquirer's situation closely enough to allow for valid adaptation or re-use.

The ability of case studies to present the information required by practitioners is summarised in Table 2.

Information Theme	Strengths/Limitations
Instantiation (e.g. Timing, sequence, case studies, teaching tips, teacher reflection	Highly variable: a template, matrix, prompt sheet or model case study produces greater consistency. The contextual detail in a case study may give considerable tacit information
Adaptability (e.g. Alternative tools, activities, approaches, resources, granularity)	High
Pedagogy (e.g. approach, aims, issues, problems, assessment mode)	well suited to representing these issues through its narrative format, familiarity in professional development contexts, and use of recognisable concepts and terminology
Discipline (e.g. domain, topic, learning outcomes)	All of these are highly likely to be represented, by convention as well as design. Discipline is a common organising principle of case study resources and this can be a problem for identifying and cross-searching studies from outside the discipline community
Environment (e.g. place, tools, delivery mode)	Again these are likely to be represented but may not be explored in enough detail for readers to identify whether the activity will reproduce successfully in a different context. Lack of consistency in case study formats make these issues difficult to identify quickly
Audience (e.g. learner characteristics, level, class size)	As with environment, these may be covered in some detail, but lack of consistency means that identifying what is covered, and where, may be difficult
Quality (e.g. peer review, evaluation criteria, student outcomes, student feedback, ranking)	Case studies are highly likely to contain reflective evaluation and some sort of account of the outcomes of the design, although the extent of this might depend on the quality of the case study itself: publication is a major driver for case study production and peer review tends to raise the quality of evaluation and hence the credibility of the study. However, studies written for publication are extremely unlikely to be produced using a standardised template or model, and may be unavailable online due to copyright restrictions.
Operational Factors (e.g. cost, time, resources/support required)	These may be well represented but may equally be difficult to identify. The production of case studies themselves represents an operational overhead. They may be produced in the course of professional development and review, in which case the overhead will be considered relatively small by the provider. As with publication, however, the trade-off is consistency of format. Experience of collecting case studies suggests that either the practitioners involved require a great deal of support or a dedicated and experienced research officer is needed to write up on their behalf.
Usability Characteristics (e.g. for understanding, inspiration, technical usability – note, these are not	A familiar format in a ubiquitous text-based narrative form. The clarity, inspiration, etc depends on the quality of the writing. The detail may make it difficult to obtain a rapid

information requirements)	overview.

Table 2. Information capacity of case studies

4.1.4 Applications of Case Studies

We can conclude that usability is significantly enhanced if case studies are deposited in at least two different formats. One should be formally structured around a standard set of data elements to enable searching, browsing and classification – this could be a metadata record or a 'skeleton' case study with brief notes in each field. The other, linked representation should provide rich situational detail and pedagogical rationale/discussion to enable deeper engagement and learning, and thus in the longer term to support effective choosing, developing and implementation. Few practitioners have the time or reward structures in place to provide such complex representations of their practice.

Table 3. summarises the suitability of case studies for supporting the various stages of sharing and reuse of learning designs.

Application of Representation	Strengths/Limitations of Representation	Suitability
Browsing	Reading and interpreting case studies takes time. Effective browsing therefore requires an additional metadata record to be appended to the case study so that browsers can identify and focus on those studies most likely to be of interest.	Low in isolation Medium if a large number of case studies are collated, a template of common elements is used, and items are metadata tagged
Choosing/Evaluating	Case studies are likely to be written in language that is accessible to practitioners and to deal with familiar concepts. However, they describe a particular instance of practice in a specific context: their application to another context requires careful judgment.	Medium May be high if 'lessons learned' or other explicit guidance points are included.
Developing	Case studies are generally designed to support learning. They can be an extremely effective aid to development in the long term, enabling practitioners to extend their repertoire and gain new skills, In the short term, however, they require interpretation and application rather than direct adaptation and re-use.	Medium With the proviso that contexts must be sufficiently similar for re-interpretation to be possible
Implementing	Case studies concern the minutiae of practice in the real world and can therefore provide valuable guidance on implementation – assuming that the context of re-use is similar enough to the original. However, they do require re-interpretation: they cannot be directly re-applied or 'run' with learners in a new context.	Medium With the proviso that contexts must be sufficiently similar for implementation lessons to be valid

Table 3. Suitability of case studies to support four stages of sharing and reuse

4.2 Video case studies

4.2.1 Description

These are case studies i.e. accounts of specific examples of practice that are communicated via video (usually including audio) rather than text. Videos may be professionally produced or may simply be captured using a cheap digital video camera or even a mobile phone. Video case studies are much less widely available than text-based counterparts, but from the limited examples available their key features seem to be:

- demonstration of an e-learning application or approach in actual use with learners;
- representation of different points of view, typically through interviews with practitioners and learners, and occasionally other key stakeholders (support staff, managers, researchers).

In addition, a narrative account of the practice may be given by the practitioner involved or by a voice-over. As for written case studies, this might or might not include analysis such as the pedagogic rationale for particular design decisions or details of an evaluation. Participants in the Mod4L wiki cited instances where video/audio files had been used to enhance written case studies and PowerPoint presentations of case study material.

4.2.2 Example

Video case studies have been developed to accompany many of the **JISC e-Learning programme** case studies (see references above page 25). This involved a professional production team. Interviews were carried out on site using an interview schedule based on the case study template, plus recording of real learning situations and interviews with learners and other stakeholders. There was considerable post-production including addition of a voice-over. The videos have been adopted for staff development as part of the Effective Practice and Innovative Practice publications from the JISC, though there is insufficient data from present evaluation findings to determine whether their usage had been significantly different from that of the written case studies (McNaught 2005).

The **Effective Lecturing project**[33] used a similar process to produce high-quality video case studies of communications and information technology use in lectures. Comments from developers who had used the resource indicate that the video format was valuable for promoting discussion about practice and for helping new lecturers extend their repertoire.

The **TESEP** project has produced a number of high quality video case studies as part of its dissemination activity[34] These have yet to be evaluated.

Participants on the Mod4L wiki reported using video samples: 'to demonstrate teaching methods to teacher education students'; 'to capture a number of examples of current practice' and 'to record student presentations to help learners critique their own performances and improve their skills'. In all cases the video clips were used as supplementary forms of representation, and the emphasis was on rough-and-ready capture of material rather than quality production and presentation. One participant used the JISC template to write up a case study and then developed the same case into an outline video proposal.

4.2.3 Utility of representation

When compared with written case studies, the video format has a number of advantages. Research carried out in 2001 (Beetham, 2001a) found that innovative practice was most likely to be adopted if naïve practitioners could witness 'the real thing, in the real context, with the real people', and time-based media seem ideal for getting close to this experience. Anecdotally, practitioners are good at picking up technical and pedagogical cues from information presented in this way. It is obviously much more immediate, rewarding and 'real' to witness learning via a video or audio recording than via a written record, and participants on the Mod4L wiki noted that it was also more inspirational: *'video provides a link with real people that stimulates interest that a written account may not'.* Presenting different voices/faces also draws attention to the fact that a learning experience has a different meaning to different actors involved, which is often lost in other representational formats. And finally, some professionals learn better from video and/or audio materials, including dyslexic learners.

However, evaluation of the JISC video case studies found that practitioners experienced them as too 'slick'. They found little evidence of evaluation or analysis, and lent less credibility to the video records than to the written versions. This finding was to some extent confirmed by participants on the Mod4L wiki. One commented that deeper analysis might be achieved '*with a longer film (cf. Panorama) but the time required for all the various stages of that sort of production would be prohibitive'!* While video brings 'real people' to life, there were also concerns that this might detract from the underlying message of the case study, especially if the people on film came across as unsympathetic. Video clips to accompany a written record were generally seen as more valuable than stand-alone video.

As with written case studies, the production cost of video impacts on its utility as a representational form. An experienced user commented that '*making a formal video of a professional standard is quite a burden'*, and reported that even a 3-5 minute clip, recorded by the teacher herself, could take up to 8 hours to plan, capture, edit and prepare for use..

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[33] see http://www.effectivelecturing.scotcit.ac.uk/

[34] see http://extranet.lauder.ac.uk/QuickPlace/tesep/Main.nsf/h_92D5EB00E9D8F9DB852569D200502AD9/72B2B2F2B5E8444E802571DF006E845F/?OpenDocument

Table 4 indicates the ability of video case studies to present the information required by practitioners for sharing and reuse of learning designs.

Information Theme	Strengths/Limitations
Instantiation (e.g. Timing, sequence, case studies, teaching tips, teacher reflection	Highly variable, depending on the way the video is edited and the purpose for which it is put together. Teaching tips may be evident and teacher reflection can be well supported
Adaptability (e.g. Alternative tools, activities, approaches, resources, granularity)	Unlikely to be represented unless they were present in the instantiation recorded. They could potentially be represented in interviews or voice over
Pedagogy (e.g. approach, aims, issues, problems, assessment mode)	Highly suited to recording pedagogy in action; less effective at analysing approaches, aims, issues and problems, though consideration of these may be covered in an interview/voice-over.
Discipline (e.g. domain, topic, learning outcomes)	These may be covered in an interview/voice-over or may be apparent from the situation recorded.
Environment (e.g. place, tools, delivery mode)	Visible features of the situation and of the learners involved will be well represented. Other features may need to be drawn out by interview or accompanying text.
Audience (e.g. learner characteristics, level, class size)	As with the environment, these may be visible and well represented. Other features may need to be drawn out by interview or accompanying text.
Quality (e.g. peer review, evaluation criteria, student outcomes, student feedback, ranking)	Video case studies are highly likely to contain information about outcomes, and teacher and pupil reflections. The quality of the videos themselves is often poor.
Operational Factors (cost, time, resources/support required)	These are unlikely to be well represented except for resources that are visible in use. The operational costs of producing a video case study itself is very high if a quality product is required. Time resource and support may still be high even if low-quality video is captured by participants
Usability Characteristics(for understanding, inspiration, technical usability – note, these are not information requirements)	Potentially these are very high, both for conveying understanding, clarity, and inspiration – however the difficulties of making high quality video is a severe limitation on usability

Table 4. Information capacity of video case studies

4.2.4 Applications of video case studies

As for written case studies, with the following additional notes.

Application of Representation	Strengths/Limitations of Representation	Suitability
Browsing	Tagging video (and audio) files for effective classification and browsing presents even greater difficulties than tagging textual case studies.	
Choosing/Evaluating	Visual medium preferred by some users to give a rich view of 'what really happened'; video and audio to give a 'link with real people that stimulates interest'. However,	

	evaluation of JISC video case studies suggests that this effect is off-set by a perception of video as a persuasive, immersive ('slick') medium in which objective analysis is usually lost.	
Developing	Due to the immersive nature of the video medium, and the lack of generalised analysis, it may be more difficult to abstract from one context and apply to another for development and implementation.	
Implementing		

Table 5. Suitability of video case studies to support four stages of sharing and reuse

4.3 Controlled vocabularies

4.3.1 Description

This definition is taken from a recent report into pedagogical vocabularies (Currier et al, 2005):
A controlled vocabulary is a vocabulary consisting of a prescribed list of terms or headings each one having an assigned meaning. The way a controlled vocabulary defines the relationships between these terms or headings will vary in degree of complexity according to the purpose of the vocabulary, from simple alphabetically arranged flat lists to ontologies with richly defined relationships. A controlled vocabulary is usually contrasted with the use of natural language to index resources, in other words, terms and headings that an indexer assigns without reference to whether the term is being used consistently or what its relationship is to other indexing terms.

Controlled vocabularies can usefully be attached to fields in a template, matrix or metadata schema to further delimit the ways in which a learning entity (activity, object, environment) can be described, making the complexity of learning situations more manageable by computer-based systems and supporting more powerful browsing, searching, and other information services.

Within the general field of controlled vocabularies, the terms 'taxonomy' and 'ontology' are used to describe different types of structure that may be imposed on the list of terms. Strictly speaking a taxonomy entails a classification scheme, usually hierarchical (as in Bloom's taxonomy of learning outcomes), where members of sub-classes relate to higher classes by being examples of that class. An ontology is 'a *model for describing the world that consists of a set of types, properties, and relationship types*' (Garshol, L, 2004, cited in Currier et al 2005) where a much richer set of relationship types is possible than the simple 'is an example of' that exists in a taxonomy. Topic maps represent a complex domain through a looser and non-hierarchical network of relationships, though the rules governing how topic maps can be *represented* are quite strict[35]. All types of structured vocabulary, because they dictate certain relationships between terms, also carry implications for how the 'real world' represented by those terms is organised. Although information scientists have devised ways of evaluating the validity of a taxonomic structure, in the end it is a convention which experts in the relevant area agree to use, and it can be contested from a competing point of view. The term 'folksonomy' has grown up to indicate systems of terms, and usage of terms, that have grown up in a community without any objective criteria for selection or clearly stated rationale (unlike, for example, the taxonomies of plants and animals we are familiar with from biology).

In education, structured vocabularies can be used describe the range of what is possible within a particular area of the domain. For example, they may aim to describe all possible learning outcomes (Bloom's taxonomy[36]), learning activities (the DialogPLUS schema, Conole and Fill, 2005) or learning technologies (typologies derived from Laurillard's Conversational Model, Laurillard D, 2004). The learning design engine ReLOAD and the toolkit DialogPLUS both make use of structured vocabularies

[35] see http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=38068
[36] see for example http://www.nwlink.com/~donclark/hrd/bloom.html

in this way (see examples below). Indeed, structured vocabularies are highly valued in learning design projects because of the promise that they may help design tools to reflect expert educational practice and offer meaningful guidance to users. Criticisms are that such schemes are too rigid and formal, missing those aspects of a design that make it meaningful in practice. Also, as practices change, such vocabularies quickly become out of date unless they are actively maintained (e.g. the British Education Thesaurus).

Controlled vocabularies in fact have much in common with iconographic languages of design such as those used for LAMS or MOT+ sequences (icons are in effect a controlled visual vocabulary). They are useful for describing any aspect of the learning situation that varies discontinuously, or for or making a variable aspect of the learning situation tractable by abstracting it to a number of discrete categories. Numerical representation may be more appropriate for aspects that vary continuously, and this includes the very important element of ***time***, both as a quantity (learner and teacher resource) and as a datum (to enable coordination of activities within a timetable and between individuals). ***Student numbers*** is another element that seems logically to demand numerical representation, but in fact for pedagogical purposes it is often converted into discrete bands (small group, large group, one-to-one etc). Mot+ proposes 'maximum' numbers should be ascribed to each role in a learning design, for example.

Controlled vocabularies are widely used in information science and for the representation of complex knowledge domains such as learning design. The UNFOLD community has identified the need to focus on the 'preparatory' stage of design, in which a semi-formal narrative is produced from the ad hoc design activities and (often discipline-based) natural language of teachers (see Griffiths and Blat, 2005). It seems likely that this semi-formal narrative will need to include terms familiar to teachers, but that the number of terms will need to be limited and they will need to be used in a consistent manner. Controlled vocabularies are therefore central to the learning design project, and its promise of effective sharing of practice.

Alternative types of controlled language have been explored by members of the UNFOLD community. For example, pattern languages[37], Paquette's meta-knowledge model diagrams[38], and Buzza et al's Multiple Elaboration Model are all investigated by Knight et al (2005). Again, they conclude that whatever type of modelling is used, '*the development of a discourse that developers and educators can build upon will require agreement on the words that we use to describe abstractions'*
.

4.3.2 Examples

Many controlled vocabularies are in use in e-learning, though they may not be recognised as such. Participants on the Mod4L wiki mentioned, in addition to Bloom and DialogPLUS:

- Ennis' (1987) taxonomy of skills relevant to critical thinking
- Barnett's (1997) taxonomy of domains and skills for social work education
- The Scottish Credit and Qualifications Framework (SCQF)'s taxonomy of qualifications
- A matrix of markers' comments from the nursing discipline
- The DfES Key Skills scheme
- British or international standards (which often require or imply a controlled vocabulary – see note on MOT+ in section 6)

Taxonomies specifically intended for use in the field of learning design include CANDLE, 8LEM and DialogPLUS. These are reviewed in more detail in the LADIE project report (Conole et al, 2005), and in section 6 of this report. Participants in the Mo4L wiki tried using both DialogPLUS and the JISC e-Learning template and taxonomy: their responses are included in the 'Utility' evaluation below.

[37] See also McAndrew et al (2006).
[38] See for example Paquette (2003)

4.3.3 Utility of representation

Currier et al (2005) describe the potential uses of controlled vocabularies as follows:

- *Application and tool development – in particular the development of tools that support and facilitate the sharing of e-learning practice and that are usable and meaningful to teachers and learners.*
- *Personalisation - of content, tools, teaching and learning environments and knowledge and resource management strategies according to pedagogical preferences, styles and principles.*
- *Articulation – pedagogical vocabularies can help teachers and learning technologists to reflect on their practice and discuss it in coherent terms. This is of particular importance in a domain where both practice and technology is undergoing rapid development.*
- *Cross-domain communication – vocabularies act as a crucial bridge to enable cross-domain communication between developers, learning technologists, educational developers, practitioners and learners.*
- *Resource description and discovery – there is a recognised need for vocabularies that are capable of describing and managing educational content and learning designs and activities from a pedagogical perspective. This will enable teachers to learn from others practice and to exchange, shares, reuse, adapt and enhance these resources.*
- *Conceptual modelling - of the learning design domain.*

From the same report, Beetham concludes that accurate, pedagogically informed descriptions of learning designs could support:

- *More pedagogically-informed decision-making at the design stage;*
- *The inclusion of pedagogically rich information along with learning designs to facilitate their sharing, re-use, adaptation etc;*
- *Easier management of and searching for relevant learning designs (e.g. through classification according to one or more pedagogic taxonomies);*
- *Reflection on what is pedagogically appropriate and effective in learning designs.*

The expert practitioners involved in Mod4L were impressed by the potential of the taxonomies they encountered: '[a taxonomy] encourages you to think about why you design learning experiences for students in the way that you do… providing a structure to what initially may be instinctive and experience based learning design'; 'More extensive use of taxonomies may well help in reflecting on how to introduce more variety in learning design and/or to more accurately describe what is happening. It may also help bridge the gap between education researchers and practitioners (in that concepts are given a real and usable meaning)'; 'It would clearly assist in the documentation, evaluation and dissemination of learning design'. However, they foresaw difficulties in identifying which vocabularies were valid and credible, and in overcoming practitioners' natural reluctance to use such tools in preference to natural language. The DialogPLUS tool they found 'long-winded' and 'represent[ing] a large time overhead'; of the JISC tool they said: [it] 'would take far too long (a whole day?) to describe a task in this way!!!'. Time was a major consideration in the use of templates generally, but the addition of a structured vocabulary seemed to make the task both more time-consuming and less satisfying (because practitioners were constrained in how they described their own practice?). In both cases there were difficulties using the taxonomy – or agreeing with the taxonomy – to classify learning activities/tasks. This remains a major barrier to the systematic representation and classification of learning designs by practitioners themselves: learning designers are more practised at using design languages but lack the requisite pedagogical know-how.

Table 6 summarises the ability of controlled vocabularies to present the information required by practitioners during sharing and reuse.

Information Theme	Strengths/Limitations
Instantiation (e.g. Timing, sequence, case studies, teaching tips, teacher reflection)	Vocabularies for these aspects do not really exist. Some (e.g. timing, sequence) lend themselves much more readily to graphical forms of representation, while others (e.g. case studies, reflections) require a rich natural language.
Adaptability (e.g. Alternative tools, activities, approaches, resources,	Generally difficult to convey using a vocabulary, as above

granularity)	
Pedagogy (e.g. approach, aims, issues, problems, assessment mode)	Vocabularies for pedagogical features such as these are currently much more unstable and contested than vocabularies for learning content, but highly valued and under intense development.
Discipline (e.g. domain, topic, learning outcomes)	Several existing and stable vocabularies deal with these issues.
Environment (e.g. place, tools, delivery mode)	Most existing vocabularies for tools/media reference Laurillard. A service-based approach to technical development means a stable set of learning services are emerging, but these are at a lower level than what most learners and teachers would recognise as useful or pedagogically meaningful 'tools'.
Audience (e.g. learner characteristics, level, class size)	Some vocabularies exist e.g. level of study, competences, qualifications, access rights. Currently being developed within learner records and e-portfolios rather than within LD. Vocabularies for e.g. learning styles also exist. Class sizes could be describe with a simple numeral but IMS LD recommends a 'maximum' for each role, implying a discontinuous (controlled vocab) description may be more pedagogically meaningful i.e. small group, larger group, one-to-one etc.
Quality (e.g. peer review, evaluation criteria, student outcomes, student feedback, ranking)	No consistent vocabularies exist. There is a strong tendency to use scores or grades to describe attributes in the quality area, but some unstable and tentative vocabularies do exist to support tutor feedback.
Operational Factors (cost, time, resources/support required)	Not covered by existing vocabularies but again numerical values could reasonably be applied (see note on the Institute of Education planner in section 6).
Usability Characteristics(for understanding, inspiration, technical usability – note, these are not information requirements)	Using a controlled vocabulary adds to the time cost of creating a record, and practitioners often find it difficult to fit their own practice into the classification of the vocabulary, but cuts the cost of information retrieval for users.

Table 6. Information capacity of controlled vocabularies

4.3.4 Applications of controlled vocabularies

The poor showing of taxonomies in tables 6 & 7 almost certainly misses the point of controlled vocabularies. Despite the success of Bloom, their real application is not as representations in their own right but to make other forms of representation more usable (more sharable, browsable and interoperable, easier to classify and model, more manageable by computer-based systems etc). It is in this regard that they are attracting so much interest (see section 6 for further discussion).

Application of Representation	Strengths/Limitations of Representation	Suitability
Browsing		High
Choosing/Evaluating	While practitioners have some expertise in using taxonomies to write learning outcomes, there is no evidence that they use taxonomic terms to help evaluate designs against their desired outcomes.	Low
Developing		Low in isolation

Implementing	Taxonomies and structured vocabularies may be used as part of a learning design system (e.g. ReLOAD) or toolkit (e.g. DialogPLUS) but there is no evidence that they support development or implementation in their own right.	Unless used as part of learning design system

Table 7. Suitability of controlled vocabularies for supporting four stages of sharing and reuse

4.4 Matrices

4.4.1 Description

A matrix is an example of a generic tool that practitioners might use to define learning activities for students and describe how teachers support those activities and what resources might be used. Matrices are a tool often used by many different types of practitioners particularly for the presentation of analysed information. Thus, use of this form for the design and sharing of curriculum and learning experiences may hold a degree of familiarity. Matrices may be seen as tools that support the holistic design of learning activities (Masterman, 2006). They can display designs at macro to micro level, from course view to particular learning activities. As a generic tool in themselves, matrices do not guide practitioners in design but there have been some attempts to standardise matrices for the development of learning experiences.

4.4.2 Example

One type of matrix representation form is LDLite developed by Allison Littlejohn (Littlejohn & Pegler, forthcoming 2007). This form is particularly suited to the design and reuse of designs for blended learning as it guides practitioners to define the online and face-to-face issues. The matrix provides the opportunity to define clearly the roles of student and tutor and detail how learning resources and services support the teaching and learning process. Emphasis is placed on feedback with a particular column devoted to defining this information – something that is not always an explicit feature of representation forms.

Online or F2F	Tutor Activities	Student Activities	Resources and Services	Feedback

Figure 8. Figure 8. LDlite matrix representation.

An example (Figure 9) helps to illustrate how the LDLite matrix might be used.

	Tutor Role	Student Role	Resources (Content)	Resources (Services)	Assessment/ Feedback

Online	Divide students into groups; Introduce students to task and article;	Review task and download article	Online article – link to university library (.pdf file)		
Offline	Moderate discussion; Offer feedback and encouragement to students	Group discussion face-to-face One group member summarizes discussion		Discussion board	Feedback from peers within the group
Online	Comment on summaries; Post feedback to discussion board	Submit summary to discussion board Group should comment on summaries of 2 other groups	Summaries generated by each group (.doc);Feedback comments from tutor can be reused across student groups	Discussion board	Group summaries are formatively assessed Feedback from peers and tutor

Figure 9.

Figure 10. Figure 9. Example of an online discussion task aimed at producing a collaborative review of a journal article, represented through a LDLite matrix {Littlejohn & Pegler, forthcoming 2007).

The above example illustrates one level of granularity that might be supported by a matrix representation. The example is generic to a collaborative review of a journal article (that is this is an activity that could be carried out in almost any university course) however, expectations of teacher and learner are still clearly stated.

4.4.3 Utility of Representation Form

Mod4L participants in general found matrices relatively easy to interpret. However, one participant did point out that they placed greater cognitive demands on the reader than does a linear template because one has to read left to right and top to bottom at the same time:

"Are people lazy readers? By default we are. We skip words and guess words based on word shapes and beginnings. Our experience of reading direction, left to right then down, enables this speed reading. The matrix, at least for me, was harder to read and understand because I was being asked to read from left to right and top to bottom simultaneously. This cognitive demand perhaps disables the speed-reading tricks of skipping and guessing words. My eyes were jumping around the matrice to read as quickly as I could but I wasn't understanding what I was reading. You have to work harder to understand the learning representation and this may put people off."

Participants also pointed out that aims and objectives were not evident, and that the presentation as a whole was very "dry", and could not capture exciting teaching.

The information about learning designs presented in matrices may be variable depending on the developer. However, there is potential to provide quite a bit of detail. Table 8 suggests the strengths and limitations of the representation form for presenting such information.

Information Theme	Strengths/Limitations
Instantiation (e.g. Timing, sequence, case studies, teaching tips, teacher reflection	The matrix form indicates sequence, and a column for timing may be included. Columns for reflection and teaching tips for components of the design could be included, although there is a danger of the matrix becoming cumbersome.
Adaptability (e.g. Alternative tools, activities, approaches, resources, granularity)	The textual and somewhat linear nature of the form may make variation in models cumbersome. The matrix representation form could support both macro and micro level designs but might be most supportive of models at the

	learning activity level.
Pedagogy (e.g. approach, aims, issues, problems, assessment mode)	The opportunity to describe roles and define feedback/assessment is a strength of this representation form. However aims and objectives are generally not presented within the matrix. They can be provided for by a paragraph at the top.
Discipline (e.g. domain, topic, learning outcomes)	Discipline, topic and learning outcomes are not explicitly shown within the matrix, but are often summarised in a title at the top
Environment (e.g. place, tools, delivery mode)	Templates of this representation form, such as LDLite, provide scope for defining environment.
Audience (e.g. learner characteristics, level, class size)	Audience characteristics are not explicitly shown in the matrix form. Group size information may be indicated within the matrix.
Quality (e.g. peer review, evaluation criteria, student outcomes, student feedback, ranking)	The representation does not generally provide space for this information, but could be adapted to do so.
Operational Factors (cost, time, resources/support required)	Resources and support services can be clearly defined through this representation. Time needed by teachers to facilitate activities can be anticipated through the specification of the teacher roles.
Usability Characteristics(for understanding, inspiration, technical usability – note, these are not information requirements)	Templates such as LDLite provide guidance for use of the representation form.

Table 8. Information capacity of matrix representations

4.4.4 Applications of Matrices

Matrix representations may be a familiar format for practitioners and thus support reusability. Table 9 suggests the suitability of matrices to support aspects of this.

Application of Representation	Strengths/Limitations of Representation	Suitability
Browsing	While organised in conceptual themes related to roles, resources and feedback the representation is textual and may be limited in how quickly a practitioner can browse a particular model.	low
Choosing/Evaluating	A practice model in a matrix representation can be quite detailed and thus support practitioners in considering if the model will work in their context. However, there is no room for justification of the model within this form.	medium
Developing	This representation form can lend itself to a detailed understanding of a micro practice model. This would support both design and redesign activities.	high
Implementing	Expectations of both teacher and student can be clearly articulated through this	high

	representation form. There is specific opportunity to define resources and supports.

Table 9. Suitability of matrix representations for supporting four stages of sharing and reuse

4.5 Patterns

4.5.1 Description

Design patterns are derived from the architectural domain in the 'pattern language' work of Christopher Alexander. They have since been adopted in software engineering and now to support learning design.

The aim of patterns is to describe a recurring problem and the solution(s) to that problem. Patterns attempt to provide a structured way of analysing the problem and conveying 'best practice' solution. Patterns are textual in nature. Regardless of the domain, most patterns contain the following elements (adapted from McAndrew, Goodyear, & Dalziel, 2006):

- a name or title of the pattern
- a description of the context for the pattern and how it connects with a larger pattern
- the statement of the problem
- a description of the problem
- links to other patterns

While some have conceptualised the design pattern representation to include a diagrammatic representation of the pattern/solution (McAndrew, Goodyear, & Dalziel, 2006) this does not seem to be a key element of e-learning practice (cf. patterns available in the E-LEN project[39] or the Pedagogical Patterns Project[40]).

4.5.2 Example

The E-LEN project[41] aimed to create a network of e-learning centres and learning technologies organisations. While the project has closed, a Patterns Repository[42] continues to be available. It comprises design patterns that were collaboratively developed by project contributors. This project has produced a guide for understanding and producing design patterns to support e-learning. The generic structure of a pattern comprises:

- Name: should cover covers the content; be meaningful and easy to remember; and, related to the described problem and solution
- Category: pedagogical/organizational/technical
- Abstract: brief outline of the key elements in the pattern
- Problem: a detailed description of the problem.
- Analysis: justification for the problem and why a solution is needed.
- Known solutions: description of what constitutes a 'good practice' solution to the problem – may be based on existing practice, or drawn from theory.
- Research questions: a description of any research questions that are still to be solved, and ideas about possible research settings and methods.
- Context: a description of the type of context the solution is applicable to.
- Conditions: a description of critical success indicators/factors that influence use or implementation of the solution (e.g. required roles, type of resources),
- Discussion/consequences: a discussion of the consequences of use, implementation issues.

[39] http://www2.tisip.no/E-LEN/
[40] http://www.pedagogicalpatterns.org/
[41] http://www2.tisip.no/E-LEN/
[42] http://www2.tisip.no/E-LEN/patterns_info.php

- References: references for the pattern.
- Related patterns: other design patterns and research patterns
- Author(s): Contributors to the pattern.
- Date: Date of completion of the pattern.
- Acknowledgements: any other people or sources of help, information etc.

An extract from an example pattern for collaborative learning from the project is provided in Figure 10 below.

Moderation of an asynchronous on-line group

Problem

Experience teaches that a moderator can have a positive affect on the activities and learning results of on-line groups. What should a moderator do in order to facilitate effective learning in asynchronous on-line groups.

Analysis

A moderator is always acting as a sort of chair and facilitator to a meeting. In different circumstances (dependent of the characteristics and the aim of the group) the focus of the moderator can be more on the learning subject or more on the procedures and behavior of the group.

Three key-roles can be distinguished:

- Organizational. Examples of organizational moderating activities: setting the agenda, objectives, timetable, procedural rules, netiquette, encouraging the participants to introduce themselves, etc. The moderator should be wary of standardized approaches. Every discussion group comprises participants with different backgrounds, learning styles, etc. So, no standardized approach can be presumed to be appropriate for all groups. The moderator should use a diversity of approaches and have a pool of questions and discussion to stimulate the discussion. The moderator should also welcome the unanticipated. Discussion could be unpredictable and moderators should be prepared and willing to leave from the pre-defined track of discussion to follow up discussion threads that might arise unexpectedly.

- Social. Examples of social moderating activities: sending welcoming messages, thank you notices, prompt feedback, set a positive tone. The moderator should praise and model the discussant behavior bad discussant behavior should not be ignored. Reinforcing and modeling good discussant behaviors, such as by saying, "Thank You" to students who respond effectively online, can be helpful to encourage courtesy and interaction. In case competitive and emotional battlegrounds or highly personal messages will be shared, the moderator should request change (privately) using a written "netiquette" statement to refer to. The moderator should allow participants to exchange private and informal messages. In this way, trusting and social bonds can be cultivated. Of course, there should be a separate virtual place (e.g. ?virtual café?) for such kind of interaction.

- Intellectual. Examples of intellectual moderating activities: asking questions, probing responses, refocusing discussion. The moderator should read a digest report of the discussion activities of the day in order to check if participants fall far behind. The moderator should also prompt frequently by using private messages to motivate participants to take part in the discussion, to initiate debates, and to make suggestions.

The problem is when to use what activities.

Solution

In general all of the activities mentioned above should be performed; how and how often depends on the case. It is not necessary that only the moderator is responsible for all of these activities. It is often possible to delegate part of the activities to group members. This should be agreed on because it has to be clear to every member of the group who is responsible for what.

The need for moderating activities depends on:

1.desired learning effects

2.motivation and experience of the learners

3.organization of the group
4.content and form of the tasks.
5.flow of discussion (see above comments about the misbehavior, the diversion from the pre-planned topics, or even the case of having lurkers)

Ad 1: If the learning goals an tasks are clearly defined, the moderator has to see to it that the right subjects are treated, and that all subjects are treated.

If the learning goals are more open, a more spontaneous development of subjects is possible; the moderator can then summarize the goals as consented on by the group.

Ad 2: If the members are very motivated to learn and clearly understand their gain in participating in the group, the role of the moderator can be limited to refocus and summarize the discussion from time to time. If the learners are less motivated, the role of the moderator has to be more complex. He should also try to motivate each individual participant to contribute and collaborate. This is a very important task of a moderator.

Ad 3: If the group is structured and organized according to rules and procedures, the role of the moderator is to ensure these procedures are followed. If such rules do not exist, it is part of the moderator?s job to propose them to the group and have them agreed on.

Ad 4: A well structured task is easier for the moderator. The structure of the task ensuring that all subjects are covered, the moderator can concentrate on motivating students.

The moderator is free to define his/her preferred form of moderation and pedagogical style.

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Related patterns

More information on relations

Defining the goal of collaboration-Agreeing on how to collaborate-Agreements on why and how to contribute-Division of roles and tasks-Assessing group processes and products-Active and passive contribution-Lurking-Factors influencing the successfulness of a group for collaborative learning

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Type

Domain specific

Submitted date

2004-06-16

Figure 11.
Figure 12. Figure 10. Example pattern from the e-LEN project[43]

In the above example the problem has been analysed in detail with steps provided for the solution. However, many of the elements of the design (e.g., context) have not been described in this representation, and it is, indeed, debatable whether the patterns of the e-LEN project represent learning designs; the focus tends to be on tasks, pedagogic priorities, or lesson management issues, which lack the structural component of learning designs.

4.5.3 Utility of Representation Form

Participants on the Mod4L project generally were not enthusiastic about pattern representations, despite the familiar narrative style. They viewed it as an over-complicated way of presenting information, and did not generally pick up on the development opportunities offered. This dislike seems to be shared by practitioners on Staffordshire University's Models of Practice project (Helen Walmsley, private communication)

The extent of the textual description provided in any given design pattern will contribute to its utility for practitioners. Table 10 provides an overview of ability of patterns to present the information required by practitioners for sharing and reuse.

Information	Strengths/Limitations
Instantiation (e.g. Timing, sequence, case studies, teaching tips, teacher reflection	The textual descriptive nature of design patterns seem to best support the mirco level, that is solving educational problems at the learning activity rather than whole course level. The pattern is well suited to representing generic teaching tips or reflections, but not to detailed timings or sequences.
Adaptability (e.g. Alternative tools, activities, approaches, resources, granularity)	Variations within specific solutions would add complexity to the textual description of the pattern. This may make the pattern more difficult for practitioners to follow.
Pedagogy (e.g. approach, aims, issues, problems, assessment mode)	This representation form anticipates detailed pedagogical guidance within the solution. However, the generic form does provide explicit instructions on explaining the various elements of pedagogy.
Discipline (e.g. domain, topic, learning outcomes)	This representation form is not discipline specific but may be more relevant to educators within those fields (e.g., architecture and software engineering) within which pattern language may be used for practice
Environment (e.g. place, tools, delivery mode)	Details regarding situation are anticipated in a detailed description of the solution however the generic form does not necessary provide explicit guidance on this.
Audience (e.g. learner characteristics, level, class size)	As with Environment, audience characteristics may be included in the detailed description of the solution, but are unlikely in the generic form.

43 http://www2.tisip.no/E-LEN/patterns_listing.php?sig=3&show=Explore+SIG+patterns

Quality (e.g. peer review, evaluation criteria, student outcomes, student feedback, ranking)	The generic form of the representation should promote in-depth analysis in suggesting the need for justification of the problem and description of the context. Projects such as e-LEN and the Pedagogical Patterns Project provide online access to patterns. While no longer in operation, the e-LEN project did support contribution to the repository and opportunity for practitioners to rate and give feedback on patterns.
Operational Factors (cost, time, resources/support required)	Practitioners are guided to provide specific details on the resources needed to support the solution within patterns.
Usability Characteristics(for understanding, inspiration, technical usability – note, these are not information requirements)	Extensive work in the use of design patterns for education provides a detailed base to understand this representation form. However, much of this is in the published literature -- practitioners may not access these communication vehicles on a widespread basis. Booklets freely available online such as that produced by the e-LEN project are detailed and may be more accessible.

Table 10. Information capacity of Pattern representations

4.5.4 Applications of Patterns

Design patterns have the potential to support practitioners in identifying, designing and communicating best practice in a textual format. This may be a representation that practitioners are less familiar with and therefore the 'learning curve' may be steeper than for other forms, which may explain the negative reaction of Mod4L participants However, the lack of contextual information may present a less tractable barrier. Table 11 considers the potential of patterns to support the four stages of sharing and reuse.

Application of Representation	Strengths/Limitations of Representation	Suitability
Browsing	The textual nature of patterns may make it difficult for practitioners to quickly identify relevant patterns for their problem/context.	low
Choosing/Evaluating	The focus on justification of the problem and description of the context within patterns should support practitioner choice of patterns to adopt.	high
Developing	Patterns may best suit development at the micro or learning activity level. The textual form may be cumbersome to detail at a course level.	medium
Implementing	If the design pattern is developed to the detail expected form the generic form it should provide enough guidance for the practitioner to implement.	high

Table 11. Suitability of Patterns for supporting four stages of sharing and reuse.

4.6 Concept Maps

4.6.1 Description

Concept maps are illustrations that show relationships between concepts. Concept mapping is often used to stimulate ideas and to assimilate new ideas and prior knowledge. Concept mapping has been used extensively in education to support note taking, brainstorming and collaboration; as a research tool; as an advance organiser; and, to assess student learning.

The proliferation of computer software to support concept mapping may have led to less commonality in the basic structures of such representations over time. However, the elements of the traditional concept map include concepts or terms displayed as text within circles or boxes; concepts are linked and/or cross-linked by lines which are labelled with text to explain the relationship between concepts; and, in some cases, arrows at the beginning and/or end of each line to illustrate the direction of the relationship between concepts. Unlike mind maps, concept maps tend to display some degree of hierarchy with more general concepts at the top of the map. Figure 11 illustrates a typical concept map.

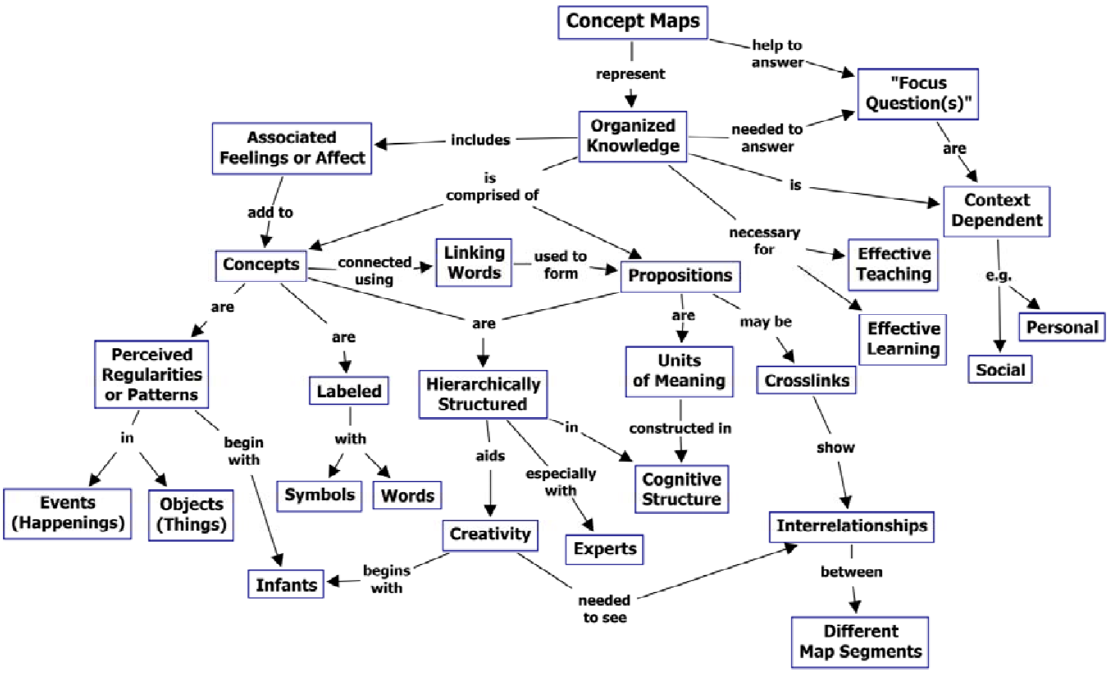

Figure 13. Figure 11. A concept map of concept maps from Novak & Cañas (2006),

Educators have been using concept maps to support curriculum design and revision for decades. The hierarchical nature of concept maps helps to display the sequencing of activities and instructional content.

The opportunity for sharing concept maps allows for collaborative curriculum design and re-development at both the macro and micro levels (Novack & Cañas, 2006). Concept maps can help practitioners identify both coverage and gaps in their program. It has been argued that collaborative concept mapping supports curriculum and teaching practice change (Edmondson, 1993; 1995). Figure 12 illustrates a concept map used in curriculum development of a genetics course.

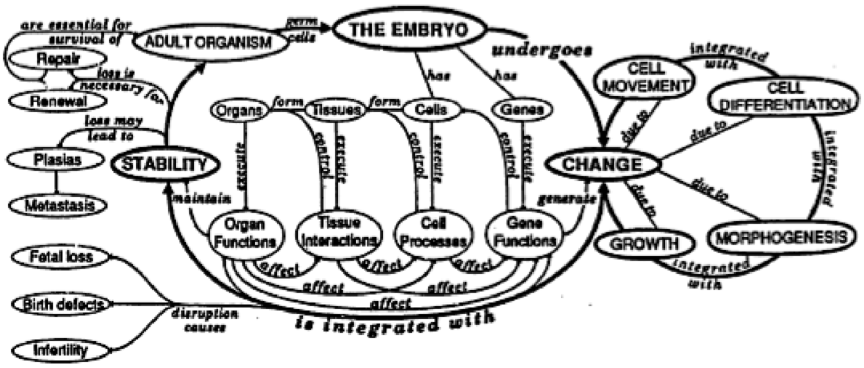

Figure 14. Figure 12. Example concept map from a genetics course (Edmondson, 1993)

Like matrices, this representation form is often used by those practitioners who see themselves as holists who see the big picture of their course/learning activity and then develop from the top down (Masterman, 2006).

It is also argued that concept maps are an educationally powerful tool for learners as they can use the process to draw their own connections between their previous knowledge and concepts that are new to them (Novak, 1991). Engaging learners in concept mapping and revealing teacher-generated curriculum concept maps to learners may help to better support their journey through a given course.

4.6.2 Example

In an effort to promote reusability across geography teaching, concept maps are one type of representation used within the DialogPlus project. Figure 13 below is an example of a concept map used to aid in the development of a series of learning activities which aimed to support the use and understanding of the Global Positioning System (GPS) (Durham & Arrell, 2006).

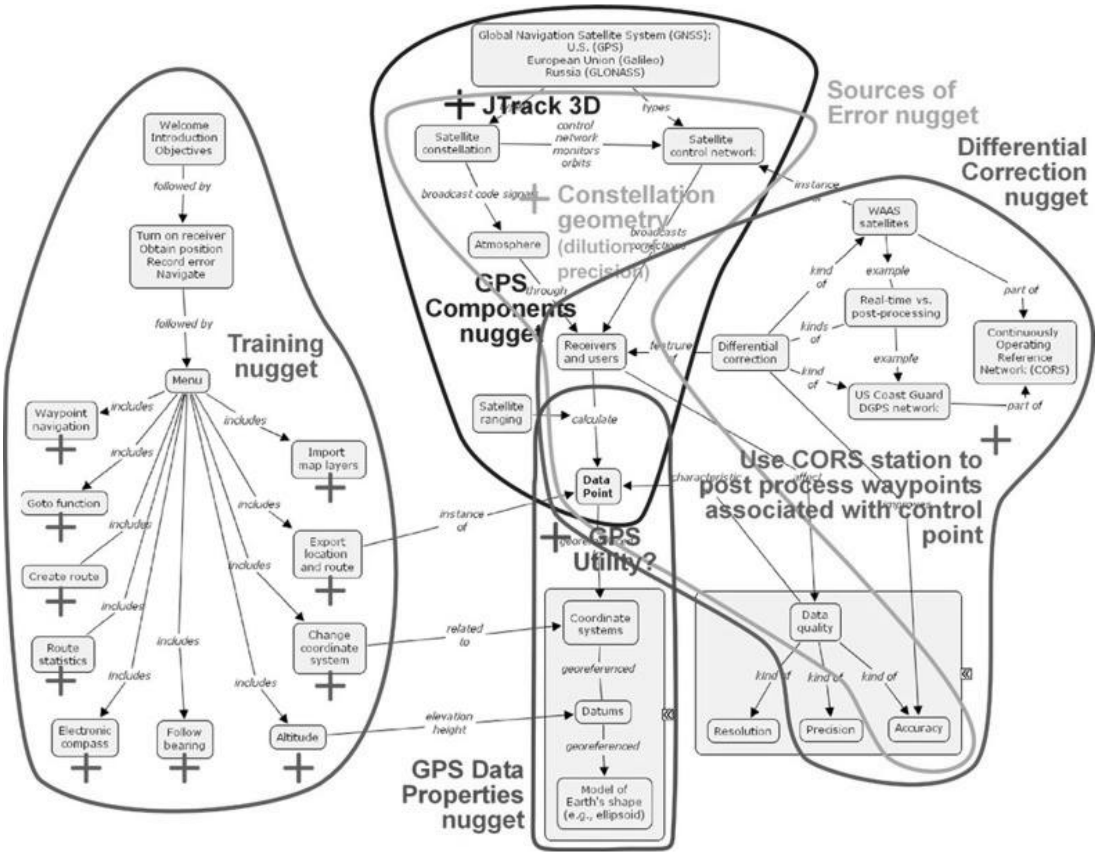

Figure 15. Figure 13. Example concept map used in the DialogPlus project (Durham & Arrell, 2006)

Within this project, concept mapping was used by a disparately located team of developers who identified the inter-related subtopics associated their main learning topic (GPS). In the concept map, sub-topics are represented as nodes (rounded boxes) and relationships are defined by labelled links between notes. The final concept map was then be analysed to develop a lesson or series of lessons.

4.6.3 Utility of Representation Form

A number of Mod4L participants used concept mapping at some stage in planning learning designs. However, one participant queried their wider utility in sharing and reuse:

"Does it make any sense to anyone other than me? I don't think it does. Brief comments. key words, etc, like those found in a learning matrix, are prompts to remind ourselves what we want to cover. I don't think these 'memory cues' mean much to anyone other than for whom they were written".

The ability to drill down through hyperlinked concept maps would, they agreed, get round this problem, but in practice, at present such maps are relatively difficult for practitioners to share due to the size and complexity of the file structures, as Mod4L participants found.

Another participant liked the ability of Mindmanager and similar systems to output in a variety of different formats, for example web pages, PowerPoint slides or a Word document.

The limitations of the formalism associated with concept maps may reduce their impact in terms of conveying information consistently. Their ability to present the information required for sharing and reuse is summarised in Table 12.

Information	Strengths/Limitations
Instantiation (e.g. Timing, sequence, case studies, teaching tips, teacher reflection	As has been demonstrated within the literature on the use of concept maps to support curriculum development, this representation form can be used at both the macro and mirco level. Although the literature also reports practitioners have more difficulty using this representation to provide detail at the micro level (Masterman, 2006).
Adaptability (e.g. Alternative tools, activities, approaches, resources, granularity)	This representation form could show alternative activities, approaches and resources, although it is seldom used in this way in practice
Pedagogy (e.g. approach, aims, issues, problems, assessment mode)	While more recent examples of the use of concept maps to represent practice models have incorporated aspects of pedagogy, there is no formalised element related to pedagogy. This lack of structure may mean developers take a content rather than pedagogy approach.
Discipline (e.g. domain, topic, learning outcomes)	Discipline elements may often be defined in the central concept of the map
Environment (e.g. place, tools, delivery mode)	There is no convention for describing environment within the concept map representation.
Audience (e.g. learner characteristics, level, class size)	There is no convention for describing the audience within the concept map representation
Quality (e.g. peer review, evaluation criteria, student outcomes, student feedback, ranking)	There is no inherent element to describe evaluation within a concept map.
Operational Factors (cost, time, resources/support required)	This representation lends itself to the definition of concepts to be covered within a practice model but does not necessary

	prescribe specific resources and supports to be used. Thus, it may difficult to determine cost through examination of practice model that use this representation form.
Usability Characteristics(for understanding, inspiration, technical usability – note, these are not information requirements)	The representation form itself is credible given the extent of research that has been conducted on its use as both a learning tool and a curriculum construction tool. There are a number of available software applications and guides available to practitioners to support the use of this representation form.

Table 12. Information capacity of concept map representations

4.6.4 Applications of Concept Maps

Given their widespread use for a variety of educational purposes, concept maps as a representation of learning designs may be well placed to support teachers in identifying, evaluating and developing learning designs (Table 13), although, as noted above, the pedagogic structure may be less apparent than the content.

Application of Representation	Strengths/Limitations of Representation	Suitability
Browsing	A practitioner's ability to quickly understand a model illustrated by a concept map may be dependent on the granularity and extent of detail.	medium
Choosing/Evaluating	Concept maps provide a visual representation of the elements and links of practice models. The strength of each model may be related to the consistency of the use of the elements and links .	high
Developing	Concept maps can be developed at a high level curriculum view or to a detailed activity-based view. Software applications that help with map construction provide links between maps and thus can support this macro and micro view.	high
Implementing	The extent of support for implementation is dependant upon the extent of the detail provided in the maps in terms of student and teacher roles, resources and supporting structures.	medium

Table 13. Suitability of concept maps for supporting four stages of sharing and reuse

4.7 Temporal sequences

4.7.1 Description

The temporal sequence representation form for learning designs was developed in Australia in a nationally funded project, Information and Communication Technologies and Their Role in Flexible Learning (AUTC, 2003). This project sought to develop generic descriptions for a range of quality ICT-based learning designs (see appendix 2) and needed a representation form to describe the critical elements of the various learning designs. The term "temporal sequence" is often used to describe processes that flow but in relation to learning design representations, the AUTC project was the first such application to use this description.

This representation mode describes learning designs in terms of three constituent elements, learning tasks, learning supports and learning resources. Figure 14 shows the nature of these elements and the characters used to represent the various elements.

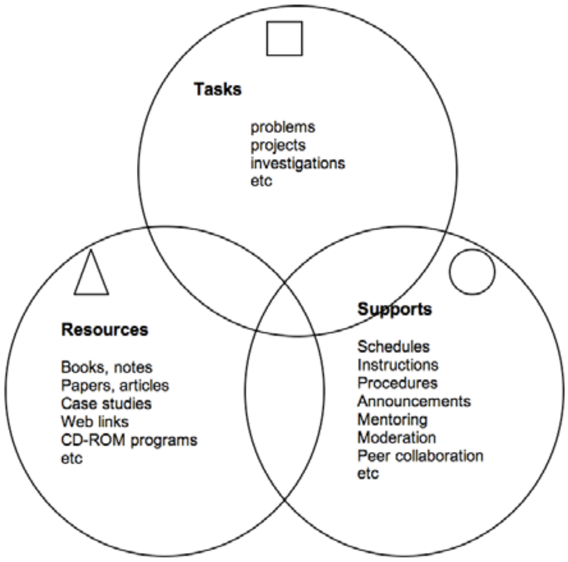

Figure 16. Figure 14. Elements of a learning design. Based on Oliver (1999) and Oliver and Herrington (2001).

The decision to use of Tasks, Resources and Supports as the key elements in describing a learning design drew from earlier work of researchers in the team (Oliver & Herrington, 2001). These elements formed the basis of a model developed to assist instructional designers to create online learning environments in a large national project. The Tasks, Resources and Supports framework was generated to encourage the instructional designers to move away from a focus on content and to plan their learning environments using tasks and problems as the primary contexts for learning with resources and supports provided as complements to these activities. It was found in many practical projects involving the design of active learning environments that when instructional designers and teachers used this framework to guide their planning, they tended to develop learning settings that provided high levels of learner engagement and activity. The framework was used successfully with many designer and teachers in the design of learning settings that promoted student engagement and knowledge construction.

In developing the temporal sequence representation form, it was felt important to have a means to describe learning designs in ways which could show learner activities as a sequence of inter-related interactions with tasks, resources and supports. The representation flows down and arrows reveal the interactions.

The AUTC system is discussed further in section 5

4.7.2 Example

A typical temporal sequence representation is shown in Figure 15. This example shows a temporal sequence representation of a problem-based learning design used to help pre-service teachers learn about the various forms of assessment strategies that can be used in mathematics classrooms.

When one observes the learning design in Figure 15, it shows the tasks that students undertake. There are three tasks shown in a sequence and these start with the observation of a demonstration, an investigation of assessment strategies based on an authentic task and a team presentation of a report. As the students undertake these tasks, the representation shows the resources that are able to support their learning and the various forms of teacher support that are provided at the various times. The flow of the learning is represented through the placement of the various icons and the arrows that connect them.

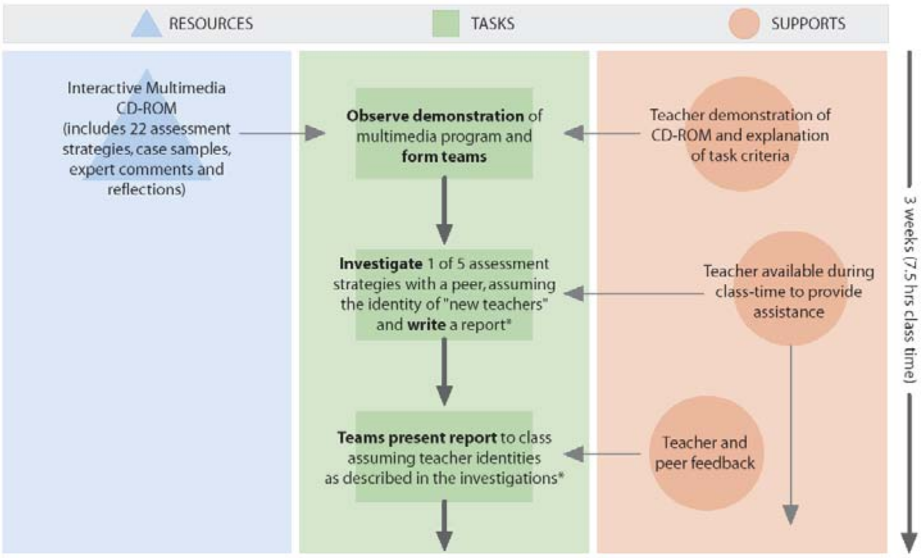

Figure 17. Figure 15. Temporal sequence representation of a problem-based learning design.

The temporal sequence representation was developed as a means to describe learning designs to teachers to provide them with an understanding of alternative teaching approaches and to encourage them to consider using alternative approaches in their teaching. The approach was intended to provide a means to describe complex learning designs applied across a sustained period of time, for example a complete semester. As such it needed ways to provide macro more than micro descriptions of learning designs.

4.7.3 Utility of Representation Form

As noted in section 3.1 one of the problems for Mod4L practitioners in using the AUTC temporal sequences was in seeing where they, as teachers, fitted into the design:

“One of the hardest things I found when trying to do this for the example activity listed above was see where the input from staff fitted into things … In this task there were several instances where a staff intervention was needed: to form an aggregated list, produce a top 5 ranking and summarise outcomes at the end of the activities). I found myself putting these as "resources" (for the learners to subsequently use) but was a little uneasy at not being able to specify how they got there!”

For this reason they suggested that the sequence might be more useful to the students, enabling them to orient themselves in the design, than to the teacher. They recognised, also, that the representation might be better suited to online teaching, where teacher intervention is a step removed from the learner.

In terms of the forms of information that are contained in representations of learning activities developed using the temporal sequence, some elements are better presented than others (Table 14). In general, the temporal sequence representation provides a visual overview of the structure of a design, and a means to describe the procedural elements in learning activities more than the intrinsic elements associated with reuse.

Information Themes	Strengths/Limitations
Instantiation (e.g. Timing, sequence, case studies, teaching tips, teacher reflection	The temporal sequence representation gives a clear indication of sequence, and timing can be shown in a vertical line at the side. There is no place for case studies, reflection or teaching tips
Adaptability (e.g. Alternative tools, activities, approaches, resources, granularity)	This representation has no prescribed form for dealing with variations in such aspects of the learning setting as diversity among learners, alternative delivery modes Nor does it provide much flexibility to cater for learning designs with distinct variants. These would most likely

	be best dealt with through the development of separate representations. The overall representation can become quite large and clumsy when the learning design is comprised of smaller activities each of which needs to be described in detail.
Pedagogy (e.g. approach, aims, issues, problems, assessment mode)	In the temporal sequence form, there is no prescribed place to describe such intrinsic elements of the learning design as aims, pedagogies etc, although assessment mode may be shown as a task with associated resources and supports
Discipline (e.g. domain, topic, learning outcomes)	In the temporal sequence form, there is no prescribed place to describe such intrinsic elements of the learning design as discipline, intended outcomes, although brief information is sometimes included in a title bar
Environment (e.g. place, tools, delivery mode)	.This form of representation shows clearly what the environment must provide in the way of support; The precise tools used could be specified, but need not be.
Audience (e.g. learner characteristics, level, class size)	There is no prescribed place to describe elements such as learner characteristics, class size, or level in the temporal sequence form.
Quality (e.g. peer review, evaluation criteria, student outcomes, student feedback, ranking)	This representation has no intentional components or capabilities to describe evaluation processes against which the learning activities themselves might be assessed and reported.
Operational Factors (cost, time, resources/support required)	The resources component of the representation provides the opportunity to prescribe resources but the description is intended to include only learning attributes. Other characteristics such as costs and physical descriptions would need to be described elsewhere,
Usability Characteristics(for understanding, inspiration, technical usability – note, these are not information requirements)	The representation form has its own unique structures and elements, which although quite self-explanatory, need to be explained to first-time users and which can take some time to be used comfortably by novice users. The representation is not overly prescriptive in what has to be contained in the description and this means that different people could conceivably describe the same learning activity quite differently with this representation.

Table 14. Information capacity of temporal sequence representation

4.7.4 Applications of Temporal Sequences

The temporal sequence is a representation which is suited to supporting teachers understanding and choosing of a learning design and potentially developing a form for their own use, more than assisting their discovery and classroom implementation, although use of a controlled vocabulary would aid discovery. The representation was designed to provide a means to describe the overall form of learning and as such is well suited for teachers who want to compare learning designs (Table 15)..

Application of Representation	Strengths/Limitations of Representation	Suitability
Browsing	A unique representation form not likely to be familiar to teachers. Difficult to tell at first glance how effective the LD might be and the theoretical/pedagogical underpinnings.	low

Choosing/Evaluating	Provides visual representation of the learning design indicating constituent elements	high
Developing	A macro level description of a learning design. Does not provide much support for teachers seeking to reuse. For example, no inherent descriptions of problem types, resource forms etc.	medium
Implementing	Representation is lacking in detail needed to support teacher implementation. Descriptions too broad and general.	low

Table 15. Suitability of temporal sequences for supporting four stages of sharing and reuse

Teachers browsing to discover potential learning designs would probably find the nature and form of the temporal sequence representation difficult to understand without any prior guidance. The representation uses a series of conventions that need to be known and understood to fully appreciate and comprehend the ideas that are contained. There is nothing in the representation itself that suggests the scope and forms of learning outcome that can be achieved so it is not a very powerful medium for showcasing learning designs for this purpose.

Teachers wishing to reuse a learning design in their own setting would receive some support and assistance from a temporal sequence representation. The representation shows the need for the particular learning elements needed e.g. problems, resources and supports and these can be well articulated in the representation. But that macro nature of the representation would suggest that many of the important details a teacher might need are not necessarily evident.

In terms of implementing the learning design in a new setting, the temporal sequence is lacking in the detail needed and as such would provide very poor support for implementation. Teachers would need much more information to facilitate a smooth implementation that the representation provides. Such elements as the scope and extent of resources needed, the depth of information, how to support independent learning etc. are all missing. The representation does not have any specific teacher directions and reflects mainly learner activities, a feature that would limit its support for development and implementation.

In the AUTC project, the Website developed to support the reuse of learning designs, recognised the limitations of the temporal sequence representation for the development and implementation phases associated with reuse and provided copious pages of further description to assist teachers in these activities. The extra information included such items as:

- detailed descriptions of tasks including the identification of critical tasks, task sequences, authenticity considerations etc;
- detailed descriptions of support forms and types and how teachers might encourage their use, essential supports and strategies to cater for diversity among learners;
- detailed descriptions of supporting resources including resources forms, contextual resources and student choice;

Supporting implementation notes included discussions of

- the setting e.g. time frames, mixed-mode delivery, cohort size etc.
- forms of learning outcomes achievable;
- assessment strategies;
- ICT contributions;
- reflections from teachers who had used the learning design;
- evaluation results from previous instantiations.

All of this information would be very useful and helpful in supporting the reuse of any learning design but had no formal place in the temporal sequence representation itself.

The application of temporal sequences and other sequencing representations is considered further in section 5.

4.8 Flow diagrams

4.8.1 Description

Flow diagrams are commonly used for representing processes and a process which is reasonably well suited to describing learning activities. Flow diagrams are comprised of a series of shapes which are drawn in relation to each other with connections between each indicated. Through the use of different shapes, quite complex processes can be represented in ways that are quite intuitive and easy for a layperson to follow. Flow diagrams are often used to show the logic of computer programs and in this application, a number of standards and specifications have been adopted to simplify and improve the representation process.

There is no set of standard symbols and images at this stage for the use of flow diagrams in representing learning designs. The temporal sequence discussed above is a form of flow diagram which does have a prescribed form for the symbolic elements. Anyone wishing to use a flow diagram to describe a learning activity would first need to decide what aspects of the learning activity need to be articulated and then to decide how the a variety of boxes and shapes might best be organised to represent the salient elements of the activity.

4.8.2 Example

Figure 16 shows a learning activity represented by a flow diagram. The sequence of the shapes on the page suggests where the activity starts and where it leads from this point. The arrows suggest the sequence and the position of the figures on the page suggest concurrency and structure. When one reads the various descriptions in the shapes, the questions of how much information and what information needs to be included, become apparent.

For flow diagrams to represent learning activities adequately to support reusability, they need to contain quite a large amount of information which may be hard to provide in this format. If they are to be used simply to provide an overview of the forms of teacher and learner activity (without actually providing the detail), for example a blueprint, they would appear to be quite useful strategies.

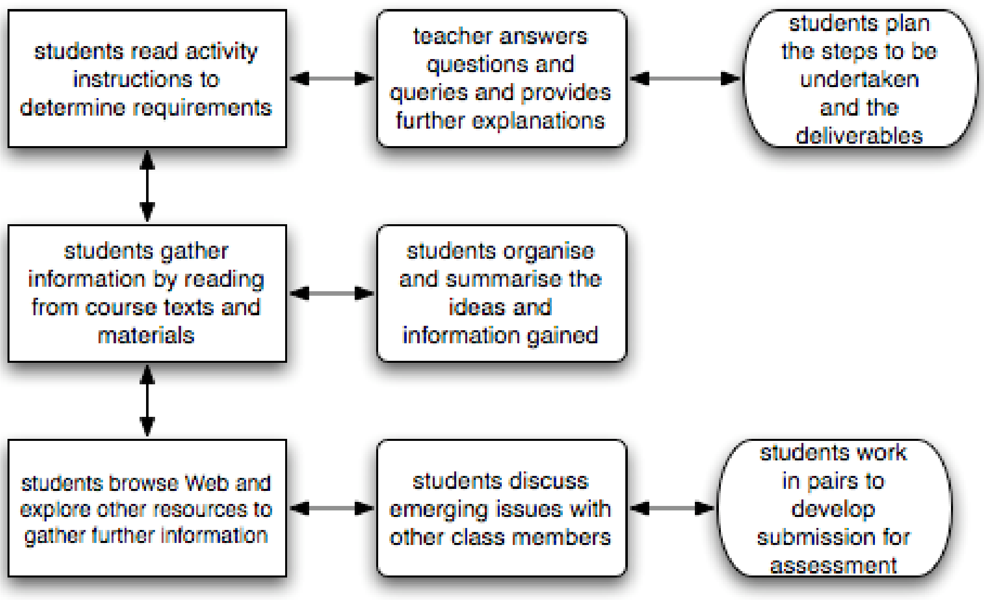

Figure 18. Figure 16. Flow diagram representation of a problem-based learning design.

4.8.3 Utility of Representation Form

Flow diagrams provide the means to show the constituent elements of entities together with connections between them. There is no formal strategy for representing learning designs using flow diagrams although it is likely that if this strategy was going to be used, the users would develop a series of consistent elements that could be used to distinguish constituent elements. In such an event, the flow diagram would likely be accompanied by a legend showing the various elements and descriptions of the connections and linkages between each, and this is something that Mod4L participants requested when trying to share designs this way.

Table 16 describes the utility of the flow diagram as a representation form in terms of the forms of information about the learning activity that can be presented in typical descriptions made with this tool. As can be seen from the descriptions, much of the intrinsic information about learning activities would not be evident in descriptions but the system does provide the flexibility for some of this information to be included if it is needed.

Information Themes	Strengths/Limitations
Instantiation (e.g. Timing, sequence, case studies, teaching tips, teacher reflection	Flow diagrams give a clear indication of sequence, and it is possible to include timing information in the nodes, or links between nodes. There is no place for case studies, reflection or teaching tips
Adaptability (e.g. Alternative tools, activities, approaches, resources, granularity)	Flow diagrams can be developed with elements to show decisions and alternative paths. Such elements add to the complexity of the representation but can be accommodated in the system. Complex processes can be broken down into constituent elements and separate flow diagrams used to provide a macro view of the micro processes.
Pedagogy (e.g. approach, aims, issues, problems, assessment mode)	The flow diagram tends to show the teaching and learning processes and other descriptive elements of the learning setting are not as well represented. Assessment mode may be shown as a student task
Discipline (e.g. domain, topic, learning outcomes)	The discipline itself and discipline elements are not well accommodated by flow diagrams.
Environment (e.g. place, tools, delivery mode)	Flow diagrams can be used quite flexibly so these forms of information can be included in flow diagram descriptions. They are not easily discerned from descriptions that do not describe them intentionally.
Audience (e.g. learner characteristics, level, class size)	There are no specific elements in flow diagrams that provide this type of information
Quality (e.g. peer review, evaluation criteria, student outcomes, student feedback, ranking)	There are no deliberate elements in flow diagrams that provide this form of information for learning activities represented in this way.
Operational Factors (e.g. cost, time, resources/support required)	Cost elements are not necessarily included in flow diagrams but could be included if needed.
Usability Characteristics(for understanding, inspiration, technical usability – note, these are not information requirements)	The system provides a strong visual map to aid understanding of the processes reflected. The process is relatively simple to implement, the difficulty lies in knowing what has to be included and the detail required.

Table 16. Information Capacity of Flow Diagram Representation

4.8.4 Applications of Flow Diagrams

As with the temporal sequence representation form described above, the use of flow diagrams would appear to offer low prospects for organising the information needed to enable a learning design to be discovered through an automated retrieval process such as might be used in a digital repository. At this stage this form of representation is too unstructured and too loose to provide an adequate means of distinguishing between the various learning designs and describing different designs in a clear and unambiguous fashion. Thus it would be difficult to search for structural aspects of a design, although use of a controlled vocabulary within the flow diagram would aid searching for content, or task, for example.

In terms of providing a means to choose and evaluate learning designs, flow diagrams appear to hold considerably greater promise (Table 17). The visual nature of the representation provides the means to highlight the various components in a learning activity and even without any formal structure, it creates a representation which most teachers could easily follow to get a sense of the learning environment being described.

Application of Representation	Strengths/Limitations of Representation	Suitability
Browsing	Flow diagrams provide strong visual representations of entities and elements. They are not well suited to generic applications and would likely perform poorly to reveal the inherent instructional characteristics of a learning design.	low
Choosing/Evaluating	Provides visual representation of various elements of the learning design. No particular requirements in scope and depth of description makes it difficult to ensure necessary information for choosing is provided	medium
Developing	The flow diagram can be drawn in a fashion which facilitates micro level forms. Again, because there is no form or methodology, the representation can be used to support the reuse in an alternative setting. Would have to be a very detailed chart.	medium
Implementing	The flow diagram can be drawn in a fashion which would support implementation of a learning design. Would have to be a very detailed chart.	medium

Table 17. Suitability of flow diagrams for supporting four stages of sharing and reuse

The forms of representation required to develop descriptions of learning activities into firm plans necessarily involve a high degree of detail. And the detail needs to contain particular information. For example, in planning a learning activity it is necessary to organise the learning tasks and to prepare adequate detail in the tasks description and the manner in which the instructions will be given to students. It would be important to plan the information sources that might need to underpin the learning tasks and to consider how learners might be required to undertake the tasks, for example, in groups, teams or independently. It would be important to plan the resources that might be needed to support the learning activity, for example, technology resources, materials etc. A flow diagram could conceivably be used for this purpose but its use would require the developer to have a very firm sense of the learning activity and be aware of the depth of detail needed. However, several Mod4L participants felt that flow diagrams were extremely useful at this stage, in supporting their decision making process, and supporting differentiation, rather than in representing the learning design for others:

“I have tried to use flow diagrams … to try to work out why i make certain decisions in relation to student support… if I could give [programme leaders] a flow chart explaining what I did in all eventualities then they would be able to provide a consistent approach. This has limited success … but I think it is a good way to challenge your decision making process and try to put logic into your instinct and personality.”

*"I'd entirely agree… that this represents an excellent opportunity to test your decision making process. Doing an ad hoc flow chart to represent this activity from my point of view (i.e. staff) allowed me to incorporate many more contingencies and to plan for different eventualities. So as a representation for *me* it works well."*

For implementation purposes, again a flow diagram could be a useful representation. The test of a representation for implementing a learning activity could be obtained by considering its ability to support a teacher (and learners) who would need to follow the instructions it provided in order to carry out the activity as intended. A well prepared flow diagram would be able to provide both teacher and learners with the information needed. Again, the representation would need to provide adequate detail and direction and would need to be prepared by someone with a strong sense of the practicalities of classroom interactions and activities. The detail would need to describe where to start, how to pace the learning, how to support learners with varying needs, how to decide when to move on, how to organise the activities etc.

4.9 Learning Activity Management System (LAMS)

4.9.1 Description

The Learning Activity Management System (LAMS) is an electronic learning system that enables teachers to plan and deliver technology-supported learning activities[44]. The system uses a flexible interface to facilitate the design and development of the online settings. The overall learning activity is developed as a combination of discrete tasks which are organised and planned through a visual interface. A drag and drop strategy enables teachers to develop learning activities and to establish parameters of the learning setting. The system enables teachers to store the planned activity as a model which can be used again, and modified if required. The system was designed to support innovative and effective online learning and to facilitate the sharing and reuse of the learning activities. The LAMS system and representation does not stand on its own – efforts are being made to support it actively within a community[45], and this may be crucial to its success, as suggested in Section 2. An extensive evaluation of the LAMS system (version 1.0) has been carried out on behalf of the JISC by Masterman and Lee (2005). LAMS 2.0 is now available, and overcomes some of the limitations noted below.

4.9.2 Example

The LAMS system provides a very structured but restrictive form of learning activity development when compared to other representations. This is due to the engine that sits behind the representation which actually builds and delivers the activities as well. The system provides a visual representation which shows the activities that have been chosen and the sequence in which they are represented (Figure 17). LAMS is a representation form that can only be used within the LAMS system and as such cannot be used outside this context. At this stage of the development, some forms of learning activities are not available, for example, specific problem-based learning approaches, role plays, classroom activities.

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[44] http://lamsfoundation.org/

[45] (http://www.lamscommunity.org/

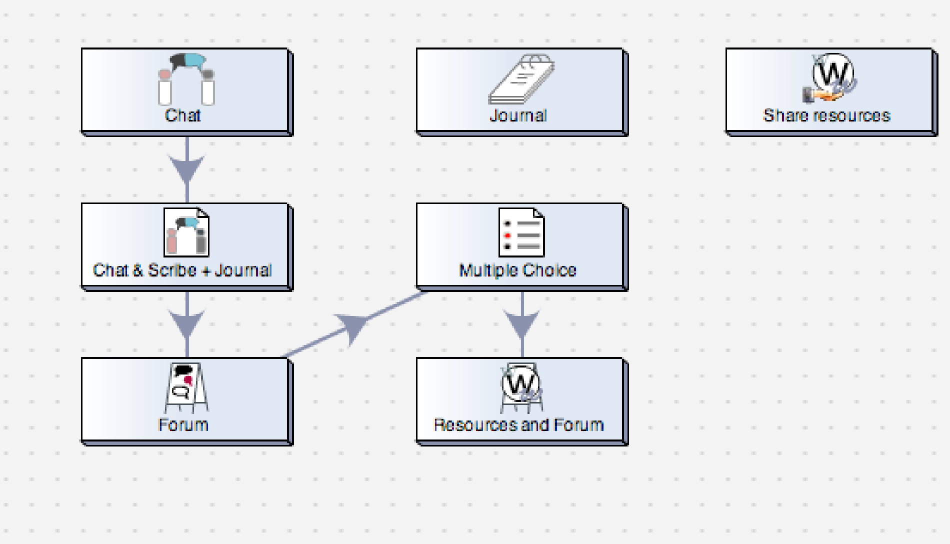

Figure 19. Figure 17. LAMS representation of a learning design.

4.9.3 Utility of Representation Form

The LAMS representation is limited in the forms of learning designs that it can represent. It comprises learning activities from the discrete set that make up the system. In some respects this is a limitation but in others a strength. Because LAMS is a closed system, there are many advantages and opportunities to be derived from the representations. Its ability to present the information requirements practitioners need for sharing and reuse reflects these limits (Table 18)

Information Theme	Strengths/Limitations
Instantiation (e.g. Timing, sequence, case studies, teaching tips, teacher reflection	LAMS gives a clear indication of sequence, but not of timing. There is no place in the visual representation for case studies, reflection or teaching tips, although these elements are provided for in the online LAMS community
Adaptability (e.g. Alternative tools, activities, approaches, resources, granularity)	LAMS as a representation form does not support variations. Each representation follows an identical set of activities. The granularity of the elements in a LAMS representation is fixed and comprises the various activities and their linking and sequencing.
Pedagogy (e.g. approach, aims, issues, problems, assessment mode)	The pedagogy underpinning the LAMS representation of a learning design is inherent, but not explicit, in the activities that are chosen and the manner in which they interrelate. A limited form of assessment modes are available within LAMS
Discipline (e.g. domain, topic, learning outcomes)	All the information contained in a LAMS representation is tied to the activities the learners undertake. Outcomes, and discipline and domain information has no explicit place.
Environment (e.g. place, tools, delivery mode)	Being a closed system, LAMS tends to implicitly restrict situational elements to those that are supported by the online system. Other physical elements cannot easily be represented with LAMS.
Audience (e.g. learner characteristics, level, class size)	All the information contained in a LAMS representation is tied to the activities the learners undertake. Learner characteristics, level and class size information has no explicit place.
Quality (e.g. peer review, evaluation criteria, student outcomes, student feedback, ranking)	The representation form itself offers no immediate facility to provide evaluation and usage data that could guide and inform future instantiations, although users are encouraged to submit designs to a repository where they may be reviewed and downloaded
Operational Factors (e.g.	Nothing specific in the LAMS system provides means to share this

cost, time, resources/support required)	information.
Usability Characteristics(e.g. for understanding, inspiration, technical usability – note, these are not information requirements)	Without a full understanding of the LAMS system itself, the LAMS representation does not provide a ready sense of the underpinning activity. The system is readily used by teachers with familiarity with LAMS.

Table 18. Information capacity of LAMS representation

4.9.4 Applications of LAMS

Within its range, LAMS scores highly as a representation form on all categories of use. It was designed as a support for learning designs and this aspect is a feature of the system. As can be seen from Table 20, the system provides a very effective way to share and reuse designs as well as being able to support teachers in understanding their processes and likely educational benefits. Whilst temporal sequence and flow diagrams were seen to offer reasonable levels of support for developing the learning activity and implementing it, LAMS rates very highly in both these areas due to its design and functionality. For those learning activities it supports LAMS provides a functional and effective means to develop learning activities and to implement them, and Mod4L participants found it easy to use. One participant however struggled with trying to represent a design that was (deliberately) less well specified than LAMS demanded:

"I have tried LAMS but … I … have struggled to represent my learning design. I feel it could still be useful where one needs to show different types of learning medium or tools in a specified sequence of tasks."

Application of Representation	Strengths/Limitations of Representation	Suitability
Browsing	LAMS learning models can be saved and shared with others. The use of a restricted set of elemental components makes the system supportive of browsing and access.	high
Choosing/Evaluating	Within the LAMS environment, the visual representation form provides an excellent means to showcase activities to enable teachers to understand their likely potential.	high
Developing	The LAMS system was designed to facilitate the development of learning activities and to make revisions and modifications. Once again, it is important to recognise the system is limited to use within its own contexts.	high
Implementing	LAMS provides total support for implementation through the online engine that supports it.	high

Table 19. Suitability of LAMS for supporting four stages of sharing and reuse

With LAMS it is important to consider the distinction between its use as a representation form and its functionality as an online system. Separately, the representation form is quite weak because it doesn't provide that much information about the learning activities but in the context of the system, these aspects are very tightly managed and facilitated and LAMS represents a sound model for representing learning designs.

5 Sequential Representation Forms

5.1 Sequential representations

Scope and sequence – this has traditionally been a basis of curriculum design across all educational sectors. While not suggesting learning is a linear process, structured learning activities are temporal in nature and therefore the need to be represented with some type of sequential form. Concerns with sequence and timing have been evident throughout our collaboration with Mod4L participants. They are even more important for those seeking to translate pedagogical requirements into runnable activities or tasks for learners to carry out. Time-based or sequential representations of learning activities include UML 'sequence' or 'swimlane' diagrams (see Tattersall 2004), workflows, and the graphical sequences produced by the LAMS system.

In the higher education context, it has been argued that sequence – or course organization – is at the heart of determining quality and effectiveness (Ramsden, 1992). It has even been argued that sequence is a critical element of the most micro level of learning activity that might be experienced through use of a learning object (Wiley & Waters, 2005). Against this, attempts to discriminate different theories of and approaches to learning (e.g. Mayes and de Freitas 2004) have not often focused on different types of sequence – although the AUTC project discussed below and in section 8.2.2 was an exception: rather they tend to focus on issues such as formality and authenticity of activities, locus of control (learner or tutor, including learner choice over timing of activities) and qualities of the learning interaction. Therefore while sequence is pragmatically necessary – learning does happen in time – there may be issues central to learning that are best represented in other ways. Section 6 continues this discussion.

The instructional design literature provides practitioners with guidance on sequencing learning experience (e.g., Reigeluth, 1999). Regardless of the specific model adopted, it has been argued that the sequence must be educationally justifiable and focused from the needs and perspective of the learner (Ramsden, 1992). Whether they are drawing from theory, research and/or practice in their designs, the representation must allow for explication of sequence.

5.2 Forms that illustrate sequence

To a greater or lesser extent, a number of different representation forms incorporate some sequential aspects, and several have already been discussed in section 4:

- **Concept Maps.** While not necessarily temporal, the opportunity to illustrate hierarchy of concepts provides for sequential representation. While concept maps do not have a level of formalism associated with other representations, practitioners who adhere to the hierarchal aspect of concepts maps will consistently be able to illustrate both learning activity and content sequence.
- **Flow Diagrams**. As a generic type of representation flow diagrams have the ability to represent the flow of activity in a learning design in a standard way, although at present there are few consistent sets of elements defined.
- **LAMS**. The LAMS visual representation is an example of a flow diagram that has defined a consistent, though currently limited, set of elements and is machine operable. LAMS was founded on the philosophy that, "*any attempt to share good practice requires e-learning systems capable of replicating the pedagogy of a typical classroom – that is, a structured flow of content and collaborative tasks"* (Dalziel, 2006), and thus is deliberately designed to represent pedagogy. However, the representation of sequence is also designed to work within the LAMS system, and this limits its use as a representation for other purposes: what is represented in LAMS is the tasks, broken down by the tools used. Other elements of the design, such as resources are not visually represented, even though they are provided for elsewhere in the system.
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The JISC supported DeSILA (Designing and Sharing Inquiry-based Learning Activities) project[46] uses LAMS to represent learning designs. Figure 19 below is an example of a problem-based learning cycle from the DeSILA project

[46] http://www.shef.ac.uk/desila/

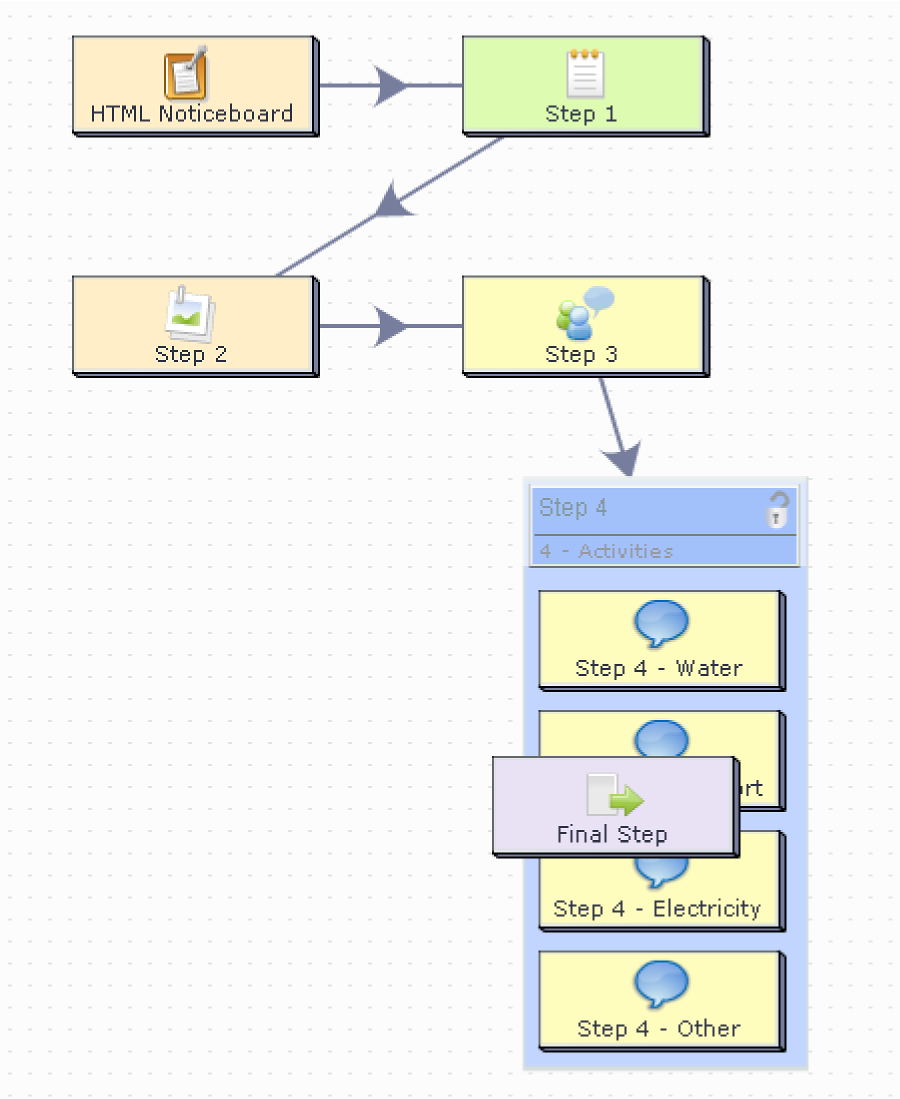

Figure 20. Figure 18 example of a problem-based learning cycle from the DeSILA project. This can be compared with the visual representation of sequence for other problem based learning designs using the AUTC system (Figure 15, and Appendix 2, section 8.2.2), a flow diagram (Figure 16) and UML (Figure 21).

- AUTC temporal sequences. Like LAMS, this system was deliberately designed to capture pedagogy. It is a more flexible system than LAMS, and presents more elements of the learning design in the visual representation, but it is designed to represent designs at a macro level. Variable usage and lack of agreement by practitioners on how to interpret the system, allied to poor provision for detailed information are a barrier to its use to support development of machine operable systems. Its pedagogic base, and its role in the development of generic learning designs, is described below.

5.3 Representation focus – Temporal Sequences

The AUTC system was developed in response to a need to be able to describe learning designs in a generic form. In the AUTC project, sixty four technology-facilitated learning approaches were identified and evaluated to ascertain their potential to support higher order and quality learning outcomes. The evaluation framework identified four elements as critical determinants of learning quality (Table 20) and the extent to which these elements were evident in the various learning approaches was used as a measure of their potential effectiveness.

Element	Description
Learner engagement.	Recognition of a learner's individual needs, taking into account prior knowledge and each learner's desires to build and develop expectations.
Acknowledgement of the learning context.	The context of the learner, the course of which the activity is part and the sites of application of the knowledge being learned.
Learner challenge	Encouragement of learners to be active and to use the support and stimulation of other learners, to take a critical approach to the materials and to go beyond what is immediately provided.
Provision for practice	Enabling demonstration of what is being learned, gaining feedback, reflection on learning and developing confidence through practice.

Table 20. Critical Elements for Effective Learning (Boud & Prosser, 2003)

Through this process, twenty five learning approaches were identified as able to support high order learning outcomes and the project then sought to establish a means to identify and articulate the learning design underpinning each. In this study, the concept of a learning design was seen as the instructional strategy employed within a learning approach. Learning designs were seen to be strategies that were independent of the context and which could be reused by others in different learning contexts seeking similar learning outcomes. In other words, they were very similar to the practice models as defined by JISC.

The project identified a number of important attributes that could be used to articulate, in a consistent form, the idiosyncratic features of various learning approaches. It was interesting to all members of the project team to discover that there was no standard or definitive process described anywhere in the literature for describing learning designs. The project sought to identify what attributes were needed to fully describe a learning design. In doing so, it found the need to develop descriptions of learning activity components in ways that were separate from implementation contexts. This process could be likened to aliens exploring the various modes of transport on earth, (e.g. cars, trucks, planes, cycles etc.) and seeking to identify the elements of transport common in each but also by which each could be distinguishable from each other, with the view to enabling other aliens to be able to select transport on earth appropriate to particular needs. In our project we had many examples of learning approaches in different settings and contexts that served common and different learning needs and it was our intention to identify particular forms and to articulate the different attributes of each that would need to be considered for reuse by others. Thus the project began to identify some of the couplings suggested in sections 2.3 & 2.6. Table 21 lists the various attributes that were initially used to distinguish and describe the various high quality learning approaches under investigation.

Attribute	Description
the forms of learning outcomes sought and achieved	e.g. forms of knowledge acquisition, skills, understandings
the nature of the learning tasks involved	e.g. rule-based, strategy-based, authentic etc.
the forms of resources required	e.g. case materials, readings, expert performance, customised resources needing development, existing resources, offline resources etc.
the forms of learning support needed	e.g. team-based approaches, collaborative groupings, teacher roles, peers, mentors, guides, scaffolds etc.
the role of technology	e.g. need for specialised software, custom tools, communication requirements, processing needs etc.
issues that need to be addressed in designing the online elements of the learning setting	e.g. levels of access to technology, document sharing, use of standard delivery systems e.g. WebCT
the skills and understandings required from learners immersed in such settings	e.g. collaborative skills, teamwork, ICT skills, expertise with software
guidelines for ensuring learners are adequately prepared for their roles and responsibilities	e.g. forms of knowledge acquisition, skills, understandings
guidelines and strategies to assist teachers to successfully design such a learning setting for their own discipline area	e.g. how to design tasks, how to build resources, how to create supports, existing models, literature
guidelines for the tutor/facilitator that will assist in their successful delivery and implementation of such a learning design	e.g. tips for successful implementation, management strategies, guiding learners, problems to anticipate, contingencies

Table 21. Template for Describing Generic Form of a Learning Design

5.3.1 Learning Designs

The AUTC project discovered a relatively high degree of consistency in the forms of learner activity among the various learning approaches and drew on the work of Jonassen (2000) to articulate a framework for describing learning designs based on the forms of learner activity and engagement involved. The project discovered that a plausible way to distinguish the learning design within learning approaches was through the nature of tasks undertaken by students in the setting. A typology describing four discrete forms of learning design was proposed. The typology identified 4 forms of learner task, rule-based, incident-based, strategy-based and role-based as appropriate to this end. Table 22 provides a summary of the forms of these four types and tasks and demonstrates the particular nature of each. In the descriptions, it can be seen that the learning design types are distinguished primarily though the nature of the task, but also through the form of resources and supports.

Learning design focus	Learning Tasks	Learning Resources	Learning Supports
Rule based processes	Closed tasks, logical and bounded tasks in authentic settings, procedural sequence	Situation-based materials, authentic resources, multiple sources, algorithmic	Collaborative learning, teacher as coach/guide, opportunities to

Learning design focus	Learning Tasks	Learning Resources	Learning Supports
	of manipulations, Projects and inquiry-based forms	descriptions and tutorials	articulate and reflect
Incident based processes	Story-based tasks with disambiguate variables, situational analysis tasks, simple decision-making tasks, trouble shooting tasks,	Incident /event descriptions and scenarios, case materials, theoretical underpinnings	Collaborative learning, opportunities to articulate and reflect, teacher as coach/guide
Strategy based processes	Complex and ill-defined tasks, diagnosis solutions, strategic performance and design tasks	Authentic resources, multiple perspectives, expert judgements, theoretical underpinnings sample tasks and solutions,	Teacher as coach, collaborative learning, peer assessments, opportunities to articulate and reflect
Role based interactions	Assumption of roles within real-life settings, assuming the role, playing the role in resolution of complex problem where the perspective is the focus of learning	Procedural descriptions, role definitions, resources to define and guide role, scenarios, theoretical underpinnings. Researched roles and personalities	Learners assume individual roles, teacher as moderator, opportunities to articulate and reflect

Table 22. A framework for a learning design typology. Sequences for these four types are given in Appendix 2 (section 8.2.2).

In order to distinguish between the various learning approaches, the project developed the AUTC temporal sequence representation in terms of the three constituent elements, learning tasks, learning supports and learning resources (Oliver, 2000; Oliver & Herrington, 2001).

From this brief history, it can be seen that the AUTC temporal sequence representation was developed with several needs in mind. These were primarily to provide a means to:

- describe the critical elements within different learning approaches;
- identify the critical elements of the forms of learning design within different learning approaches;
- articulate elements of learning approaches in a decontextualised form; and
- enable learning approaches to be reused in settings beyond their initial context.

For these reasons, the representation was developed using a visual form so that the teachers might be able to glean quickly at first glance the nature of the learning design involved. The representation sought to highlight the elements that needed to be included in reuse of the learning design in any context and this necessitated flexible and generic descriptions of elements. The use of the tasks, resources and supports elements was intended to describe the roles and activities of the various stakeholders in the application of the learning approach to enable a faithful reproduction of the original form. The focus of the representation is very much on the form of tasks that govern the student activity, but not on precise task descriptions. The same holds for the resources and the supports.

Returning to our aliens and transport metaphor, the representation was intended to enable aliens considering moving large amounts of bulky goods short distances to see, for example, using semi-articulated vehicle as a potential means of transport, and to help them understand if this is the form of transport they might choose to use, how to choose the right size engine in the truck, the right trailer and once this combination has been chosen how the truck might be used to pick-up the goods, transport and deliver them to their intended destination.

The representation provides information that is intended to showcase the learning potential of various learning approaches and to provide sufficient information to enable teachers considering reuse to know and understand the various elements they will need to develop to this end. The form of the representation provides for some aspects of reuse better than others and these have been discussed in section 4.7. One outstanding issue is the unfamiliarity of the approach. In documenting designs, there were high degrees of difference in the representations that different teachers made of the same learning approach. Teachers did not know what to include in the representation and had difficulty articulating different aspects of the learning approaches.

This aspect was evident among the participants in the Mod4L workshop held in November 2006. In attempting to develop temporal sequences for learning activities, issues that were noted by the participants included:

- uncertainty about the detail required to be included in the representation for a learning activity;
- how to represent parallel tasks e.g. reading and exploring, concurrent discussion board activities;
- what actually constitutes resources and supports. Is the VLE a support? Are pencils and papers support?
- how to represent resources, should each resource have its own triangle or can similar resources be grouped etc.?
- No discrete way to distinguish between teacher tasks and learner tasks. How to represent group tasks and individual tasks. What information needs to be shown e.g. individual learner activity or group activities?
- How to represent secondary levels of support e.g. external Web sites, online resources of an optional form;
- were the shapes to distinguish tasks, resources and supports necessary given that each was shown in its own column in the representation and the shapes themselves made it very restrictive in terms of the detail that could be included?
- learning designs tended to end up showing substantial detail at the macro level and minimal detail at the micro level. This was useful for representing learning designs but of less use for teachers seeking to implement these in specific settings;
- there appeared a need for a controlled vocabulary to describe the resources, supports and tasks so that designers had some sense of what to include and there was consistency between descriptions of the same activity;
- the length of some sequences could extend beyond a single page limiting the usefulness of the visual aspect of the representation. How could this be managed?

The sequences that were produced by the participants appeared to use the visual aspects soundly but the detail within the descriptions was inconsistent (Figure 19) an outcome which reinforced the notion that a controlled vocabulary might be useful.

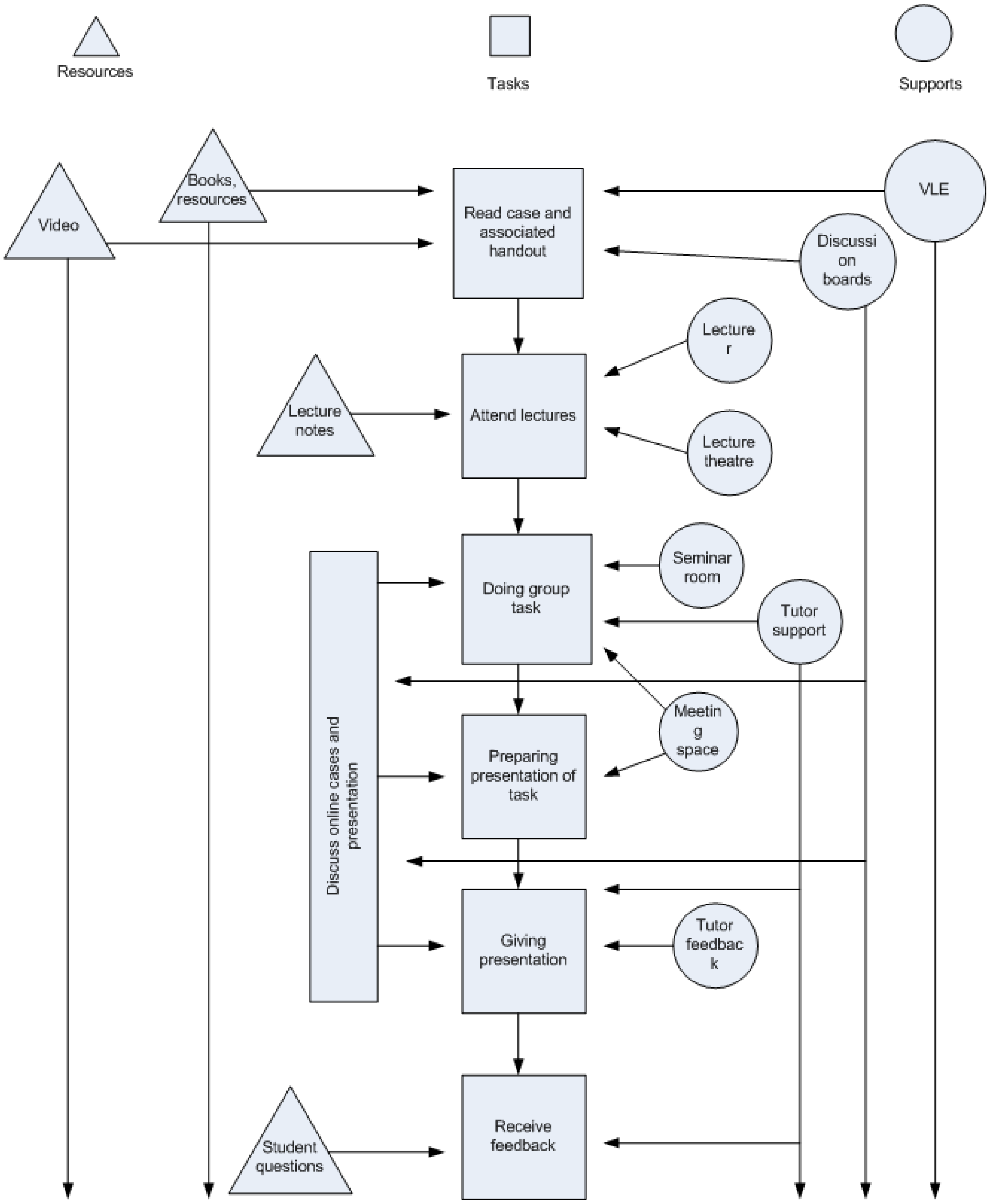

Figure 21. Figure 19. Temporal sequence representation of a learning design in social work developed at the Mod4L workshop

The learning design shown in Figure 19 shows the overall form of the learning setting but does not have any detail as to the particular activities of the teachers and students and the particular nature of the resources and supports. All this information that would be necessary for an actual implementation remains still to be described (and developed).

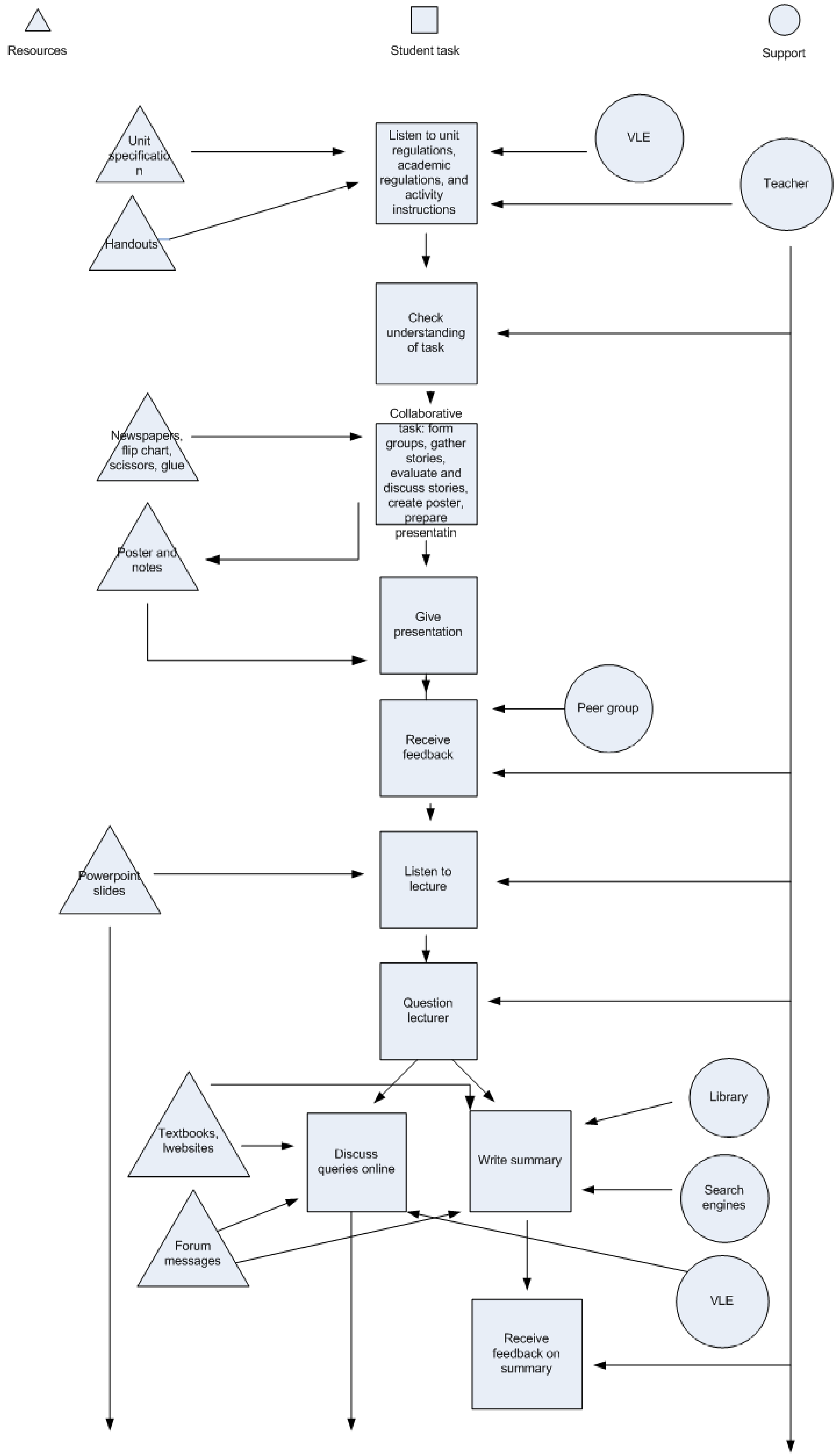

Figure 22. Figure 20. Temporal sequence representation of a learning design in Engineering Business Studies developed at the Mod4L workshop. Described by its originator as "instructivist with an overlay of constructivist activities".

In a similar fashion, use of the temporal sequence to describe a learning activity seeking to develop students' comprehension of the nature of business activity and types of business organization through a 2 hour face to face session with asynchronous follow-up revealed similar issues (Figure 20). The representation shows the various student activities (tasks) and supporting elements but there is no detail of the actual subject in the plan.

5.3.2 Strengths of AUTC Temporal Sequence Representation

The principal strength of this representation form lies in its ability to provide a visual map of the elements of a learning activity. It was designed to facilitate the description of a specific learning activity in a decontextualised manner. The elements that form the representation have been chosen to enable and support this process. This aspect of the representation system is perhaps its major strength in terms of supporting reuse of the learning design. It enables a teacher outside the context to see and understand the underpinning elements through a framework that provides descriptions.

On the other hand, the lack of contextual detail in the representation is a limiting factor when it comes to teachers seeking the detailed descriptions and information usually required for implementation. This representation is a long way away from the lesson plan type form usually associated with this form of document. In considering the utility of this representation form, there are a number of other factors that could potentially limit aspects of its use and these are described below.

5.3.3 Limitations of AUTC Temporal Sequence Representation

Novel Visual Representation. Teachers browsing to discover potential learning designs would probably find the nature and form of the temporal sequence representation difficult to understand without any prior guidance. The representation uses a series of conventions that need to be known and understood to fully appreciate and comprehend the ideas that are contained. There is nothing in the representation itself that suggests the scope and forms of learning outcome that can be achieved so it is not a very powerful medium for showcasing learning designs for this purpose.

Macro detail. As mentioned previously,. the representation provides information at a macro rather than micro level. Teachers wishing to reuse a learning design in their own setting would receive some support and assistance from a temporal sequence representation. The representation shows the need for the particular learning elements needed e.g. problems, resources and supports and these can be well articulated in the representation. But the macro nature of the representation would suggest that many of the important details a teacher might need are not necessarily evident. The representation does not have any specific teacher directions and reflects mainly learner activities, a feature that would limit its support for development and implementation.

In the AUTC project, the Website developed to support the reuse of learning designs, recognised the limitations of the temporal sequence representation for the development and implementation phases associated with reuse and provided copious pages of further description to assist teachers in these activities. The extra information included such items as:

- detailed descriptions of tasks including the identification of critical tasks, task sequences, authenticity considerations etc;
- detailed descriptions of support forms and types and how teachers might encourage their use, essential supports and strategies to cater for diversity among learners;
- detailed descriptions of supporting resources including resources forms, contextual resources and student choice;

5.3.4 Comparison between AUTC temporal sequences and UML ”swim lanes”

The “swim-lanes” UML sequence representation used by IMS LD describes learning activities by providing descriptions of the roles of the various players in learning activities. It is one of three representations used by IMS LD to document a learning design, the other two being a narrative use case and an XML document. The UML diagram lists the roles and responsibilities in a sequential fashion and indicates concurrent activities and synchronisation points where concurrent activities merge as new activities commence (Figure 21). It is interesting to compare this approach with the AUTC temporal sequence given the similarities in their presentation.

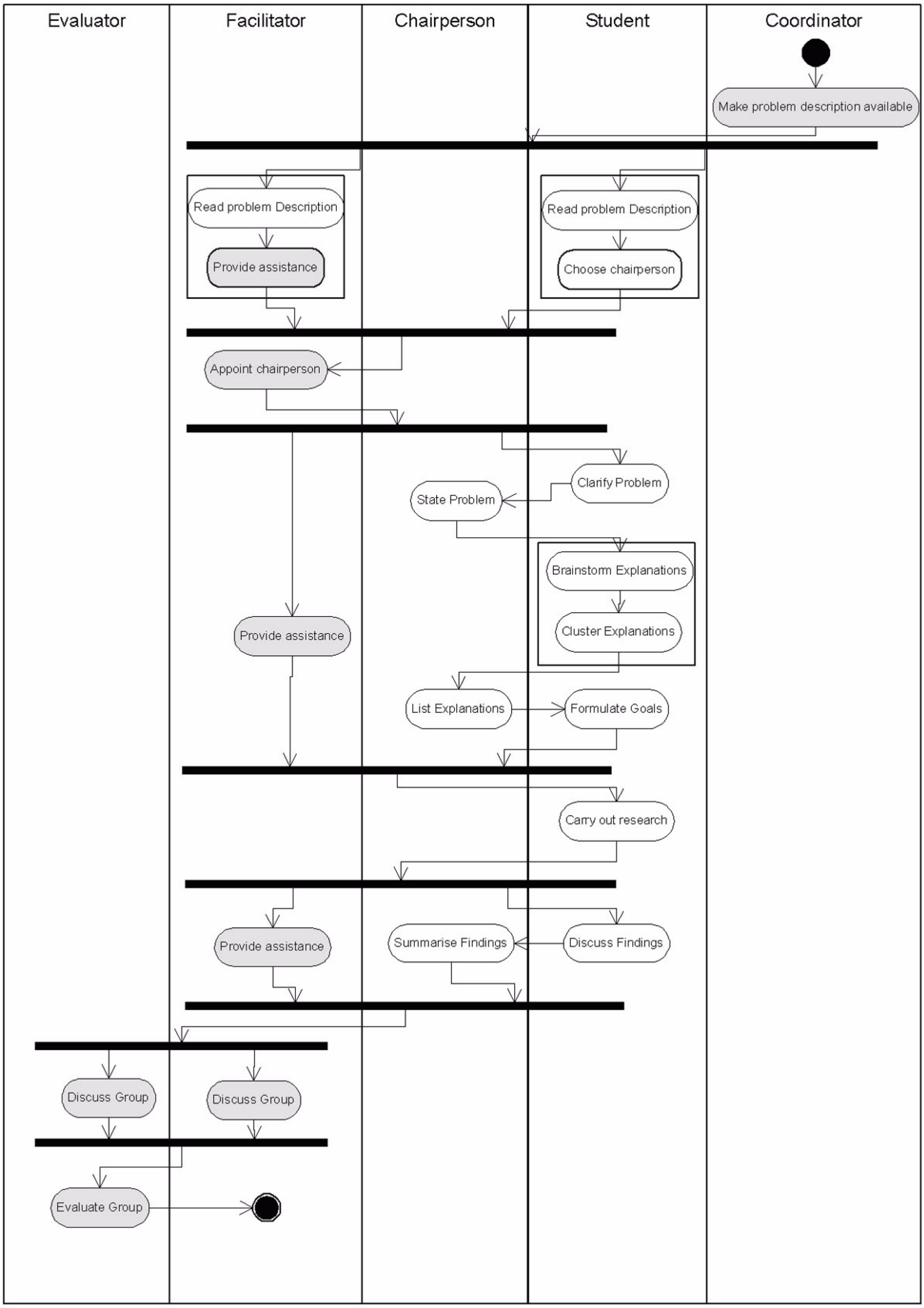

Figure 23. Figure 21. UML diagram for a problem-based learning design (IMS 2003). Compare this with the visual representation of other problem based sequences in the AUTC system (Figure 15 and Appendix 2, section 8.2.2), a flow diagram (Figure 16) and LAMS (Figure 18).

The swim-lanes approach provides much clearer guidelines for the roles of the participants in the actual implementation of a learning design. The representation clearly articulates what each participant needs to do, and when they need to do it. This aspect is typically missing from descriptions developed using the AUTC temporal sequence where the emphasis is not so much on the implementation of a learning design but more on planning the elements that are needed.

The AUTC temporal sequence would seem to be better suited to overarching descriptions of learning designs to show the scope and extent of the activities and elements. The swim-lanes approach provides a very detailed description of particular learning activities but is lacking in its ability to provide a macro view of the learning (in IMS LD these are supplied by the associated use case and narrative). For example, a role-play learning sequence might run over a 4 week period and involve many discrete learning activities. The AUTC approach provides a means to demonstrate what is involved in a role playing activity at the macro level. On the other hand, while the swim-lanes approach would be very helpful in the day to day implementation of the role play, it would be very difficult for teachers to understand from this approach how the discrete activities combined into the learning design as a whole.

These differences in the two representation approaches are highlighted when one examines where they are best used. While the AUTC approach provides a strong basis for choosing and evaluating learning outcomes, the swim-lanes would appear better suited to the development and implementation of learning designs.

5.3.5 Comparisons between sequencing models and systems

Previously in this report, several systems have been described that can be used to explore and compare the features of learning design representations as a means to examine the information that each carries and also as a means to compare their capacities to support sharing and reuse. Currier et al (2005) suggest the following seven elements as necessary to provide meaningful descriptions of learning designs and their underpinning pedagogies:

- Type of learning activity
- Desired learning outcomes
- Learning systems, technologies or services deployed in the course of a learning activity
- Other features of the learning environment
- Educational approach or theory expressed in the learning design
- Roles of participants in the learning activity)

Within the Mod4L project itself a similar set of elements was derived from first principles by practitioners seeking to articulate what they collectively saw important elements and descriptions able to strongly influence the reuse and implementation of learning designs:

- Instantiation - descriptions of timing, sequence, case studies, teaching tips, teacher reflection
- Adaptability - alternative tools, activities, approaches, resources, granularity
- Pedagogy - underpinning approach, aims, issues, problems, assessment modes
- Discipline - subject specific elements, content, learning outcomes
- Environment - the physical supporting elements ,tools/technology, delivery mode
- Audience - descriptions of learner characteristics, class size, accessibility
- Quality - information concerning peer reviews, student feedback, student outcomes, ranking etc,
- Operational - such descriptions as cost, time, support/resources required etc.

Tables 23 and 24 demonstrate the relative strengths and roles of these elements for the various representation forms described in this section above.

	Concept maps	Flow diagrams	LAMS	AUTC	UML Swim Lanes
Type of learning activity	Able to be demonstrated	Not explicitly stated, the form of the LD indicates learning strategies	Learning type is reflected in the runnable representation	Reflected in the representation which has generic elements	Individual activities clearly stated in the diagram

Desired learning outcomes	Not explicit in the representation	Indicated by the forms of activities	Not explicit in the representation	Not explicit in the representation itself	Not explicit in the representation
Learning systems	Can be determined from the representation	Not explicit in the representation	Inherent in the software system	A discrete element of the system indicates the learning systems	May be evident if systems are considered as actors with a role
Other features					
Educational approach	Not explicit in the representation	Not explicit in the representation	Not clearly stated nor intended in the representation	Able to be derived from the generic model form	Not explicit but may be derived from activities
Roles of participants	Demonstrated in the representation	Articulated in the representation	Implicit in the planned activity	Shown in the descriptions	Clearly demonstrated

Table 23. Comparison of the strengths and weaknesses of sequencing representations using Currier et al's (2005) elements of a learning design.

	Concept maps	**Flow diagrams**	**LAMS**	**AUTC**	**UML Swim Lanes**
instantiation	Well supported by the representation	Well supported by the representation	Very strongly supported through the runnable design	Representation limited in this element,	Well supported by the representation
Adaptability	Limited support in the representation	May be well supported in the representation	Limited support in the representation	Limited support in the representation	Well supported by the representation
Pedagogy	Evident from the overall design but not explicit	Evident from the overall design but not explicit	Not explicit but can be determined from the representation	Can be determined from the representation	Evident from the overall design but not explicit
Discipline	No specific discipline details	No specific discipline details	Tends to be generic and independent of discipline	Developed usually from a generic form with no specific discipline details	Developed usually from a generic form with no specific discipline details
Environment	Can be determined from the representation	Can be determined from the representation		Representation makes these elements very clear	Not well represented
Audience	Not explicit in the representation	Not explicit in the representation	Not explicit in the representation	Not explicit in the representation	Not explicit in the representation
Quality	Not explicit in the	Not explicit in the	Not explicit in the	Not explicit in the	Not explicit in the

	representation	representation	representation	representation	representation
Operational	Can be determined from the representation	Can be determined from the representation	Very clear from the representation and supporting software systems	The supporting elements are articulated	Supporting activities are well represented, but support systems may not be articulated

Table 24. Comparison of the strengths and weaknesses of sequencing representations using Mod4L information requirements for a reusable learning design (see section 3.2).

6 Taxonomies

6.1 Overview

6.1.1 Definitions

In the main, these definitions are taken from Currier et al (2005), an expert review of the field of pedagogical vocabularies funded by the JISC.

A *controlled vocabulary* is a vocabulary consisting of 'a prescribed list of terms or headings, each one having an assigned meaning'. The way a controlled vocabulary defines the relationships between terms or headings varies in complexity according to the purpose of the vocabulary, from simple flat lists to ontologies with richly defined relationships. A controlled vocabulary is usually contrasted with the use of natural language to index resources, though the development of folksonomies[47] may represent some blurring of this distinction.

Controlled vocabularies constitute a form of *classification scheme*, requiring items to be identified with one of a limited set of terms and thus arranged into classes or types. A *typology* is a simple (one-dimensional) vocabulary and the types it defines, while a *taxonomy* strictly speaking is a hierarchical system of classes related by 'is a' relationships (i.e. each sub-class is made up of instances of the higher class). However the term 'taxonomy' is also used more loosely to mean any structured system of controlled vocabularies (e.g. DialogPlus[48]).

An *ontology*, like a taxonomy, is a structured set of types but a wide range of different relationships are possible among those types, and these are defined within the ontology. An ontology is, then, a domain model that consists of a set of types and their properties, along with the relationships among those types. The DELTA[49] project, for example, uses the ontology language OWL to define a number of pedagogic categories or types and the potential relationships between them[50].

All controlled vocabularies constitute a form of world-view or model insofar as they reduce a potentially infinite set of real-world examples to a discrete number of types. However, structured vocabularies such as taxonomies and ontologies allow more complex modelling of the domain they represent because they specify or constrain certain relationships among model elements. For example, most models of the learning domain require learning outcomes to be closely mapped to learning activities and allow for similar controlled vocabularies to be used.

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[47] See Currier et al (2005) for a definition.
[48] See www.dialogplus.soton.ac.uk/.
[49] See http://www.essex.ac.uk/chimera/delta/
[50] See Todorova and Stefanov (2006) for a wider review of ontologies as applied to the domain of Learning Design

It could be argued that different kinds of structured vocabulary represent different *data models*. IMS Learning Design (IMS, 2003)[51], which allows controlled vocabularies to be associated with some of its data fields, represents a relational data model. DELTA, and more loosely DialogPlus, are based on ontologies and so represent object-oriented data models. The knowledge held by practitioners may be more effectively represented by a sophisticated deductive data model such as are designed for artificially intelligent expert systems, or it may not be fully represented by a data model at all. If the latter view is taken, practitioner knowledge may be regarded as at least partially *tacit* (i.e. not represented or articulated at all, but expressed in the form of contextualised actions (Eraut, 2004)), or *analogical* (working by tropical association of like-with-like rather than logical operations such as class membership or hierarchical relations).

Note that a set of controlled vocabularies may be developed in parallel without any taxonomic or ontological structure being imposed, i.e. without any formal relationships among classes or types being defined. The SeSDL educational vocabulary[52] is an example of such a vocabulary set.

6.1.2 The potential role and contribution of structured vocabularies

As discussed in 5.1.1, structured vocabularies describe not only the elements but also the relationship between elements of a learning situation. Vocabularies are self-evidently text-based, but structured vocabularies have a topographical dimension, offering a map of different elements relating to the learning situation: indeed they are often represented as mind-maps (DELTA, DialogPlus). The spatial/topographical dimension may be complementary to a sequential representation: for example IMS LD requires a number of controlled vocabularies to describe the learning activities available to be sequenced and the context in which the sequence is to be implemented. Turning this relationship on its head, Phoebe and DialogPlus both require 'sequence' to be defined *within* a structural/spatial (vocabulary based) representation of a learning situation.

Visual languages may be better at representing the relationships among fields and elements, as qualities of the relationship can be figured in a number of different ways (length of line, thickness of line, colour of line, position and size of elements, labelling of lines as in Mot+ etc). Both the MOT+ modelling software[53] and IMSLD use a graphical representation of the learning flow – as of course does UML. But controlled vocabularies are useful for enriching and at the same time standardising the information that appears with the icons, as concluded in Section 5.3.1 above – and as illustrated in the examples from sections 4.6, 4.7 and 4.9. And structured vocabularies – whether hierarchical, ontological or loosely networked – offer a different kind of logical structure to graphical representations, whereby the value of one field constrains the values that can be ascribed to another/others.

The IMS Learning Design specification, based on the Educational Modelling Language (EML)[54], has provided a particular momentum to the search for shared pedagogic vocabularies because of their perceived value in describing these learning designs and enabling their transition across different contexts. Controlled vocabularies offer easier management, searching and browsing of learning designs, Structured vocabularies, in which certain values constrain certain other values, offer even greater potential:
More pedagogically-informed decision-making at the design stage;
The inclusion of pedagogically rich information along with learning designs to facilitate their sharing, re-use, adaptation etc;
Pedagogically meaningful adaptivity or personalisation by the learner during the instantiation of designs;
Reflection on what is pedagogically appropriate and effective in learning designs.

However, it has proved difficult to identify one type of vocabulary or taxonomy that can meet these

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[51] See http://www.elearning.ac.uk/subjects/ldfold/LD/topic_view
[52] See http://www.sesdl.scotcit.ac.uk/
[53] see http://www-jime.open.ac.uk/2005/13/delateja-2005-13-paper.html
[54] http://eml.ou.nl/ - see **Report 2: Vocabulary Management Technologies Review**, *Section 4.4.2*, for discussion of educational modelling languages and IMS Learning Design.

different requirements. For example LAMS and the IMS LD spec (as realised through e.g. the RELOAD editor) are designed to support run-time delivery, but have a secondary role as sharable representations to support adaptation and re-use after the event. Their value in this secondary role may be compromised by their being tightly specified to run in the relevant delivery environment(s Note that the IMS specification itself simply represents those fields of metadata likely to be useful when sharing designs across different environments, including between design and run-time environments. The specification does not determine what values or range of values should be ascribed to those fields, nor does it describe the relationships between those values and fields except where this is necessary for technical conformance. In other words it describes a technical environment in which designing, running and sharing learning designs is made possible: it does not prescribe how designs can be made pedagogically effective, or even pedagogically meaningful. For that, some kind of secondary representation is required – not a data model but a domain model.

The LADIE reference (domain) model for learning design sets out to describe 'the key components of types of learning approaches that should be reflected in the outcomes of the design process' (Conole et al, 2005, p7). The types of approach are expressed through a series of use cases, which do not constitute a classification system (they do not claim exhaustively to describe potential uses of a learning design system or approaches to learning). The report notes that the '*usefulness [of use cases] should be underpinned by a standardised vocabulary'*. The DialogPlus taxonomy is recommended as one such tool, with the capability of describing many 'components' of the different learning approaches, but to date it is not actually deployed in the representation of the use cases. .

6.1.3 Elements required for the effective representation of learning designs/practice models

Currier *et al* (2005) concluded that the 'pedagogically neutral' IMS LD specification could be applied in more pedagogically meaningful ways if controlled vocabularies were used to describe the following elements of a learning design:

Type of learning activity
Desired learning outcomes
Learning systems, technologies or services deployed in the course of a learning activity
(Optionally also:
Other features of the learning environment
Educational approach or theory expressed in the learning design
Roles of participants in the learning activity)

The same review suggested that vocabularies should reflect common usage among those educational practitioners who are likely to be developing and exchanging learning designs. However, it noted that there is a trade-off between the pedagogically meaningful terms preferred by practitioners – often rich, complex and contested concepts – and system developers' needs for consistency and stability of application and for technical interoperability.

A more extended (though not dissimilar) set of required elements was derived from a meeting of pedagogical experts organised by the Mod4L project in October 2006. These were practitioners with no special expertise in vocabulary development but with a clear interest in the usability of learning designs. The elements they identified, without reference to the IMS LD specification, were:

Instantiation	Timing, sequence, case studies, teaching tips, teacher reflection
Adaptability	Alternative tools, activities, approaches, resources, granularity
Pedagogy	Approach, aims, issues, problems, assessment modes
Discipline	Discipline, subject, content, learning outcomes
Environment	Physical environment, learning environment tools/technology, delivery mode
Audience	Level, learner characteristics, class size, accessibility
Quality	Peer review, student feedback, student outcomes, ranking, date of publication
Operational	Factors Cost, time, support/resources required

Tables 27 and 29, at the end of this section, demonstrate how these required elements are served by the various vocabularies and vocabulary sets considered below.

6.2 Controlled and structured vocabularies for learning design

This section considers how a number of controlled and structured vocabularies have been developed, or adopted from general use, to support learning design processes, either with the IMS Learning Design specification in mind or to support other kinds of modelling in an e-learning context. Not included in this survey but central to it are Bloom's Taxonomy of Learning Outcomes[55] and Laurillard's typology of educational media (Laurillard 2004), well-established vocabularies that were developed to describe (aspects of) the learning process from a particular theoretical stand-point. Also not referenced but important to mention is the Scottish Educational Staff Development Library (SeSDL) taxonomy, which was drawn up on principles of vocabulary usage and stability (i.e. bottom-up) rather than to support a specific educational theory (top-down). It remains one of the most comprehensive and credible taxonomies in this area. The fact that these three are still referenced and drawn upon (e.g. Bloom's Taxonomy, in the case of LearningMapR, SeSDL and Laurillard in the case of DialogPlus) may be taken as an indication of their conceptual validity and robustness.

6.2.1 DialogPlus

The DialogPlus project[56] develops and deploys reusable digital learning objects (known as nuggets) through the Alexandria Digital Library. The project has developed a 'taxonomy' (classification system) which defines seven elements of a learning scenario, of which the requisite elements are learning outcomes, attributes, tasks and roles, and the optional elements are tools, resources and outputs. This classification system has been developed into a toolkit for planning learning activities. The tutor enters information on the learning objectives, resources available, roles (of students and tutors) and outputs, and a range of learning activities is suggested. This entails a secondary level of modelling, independent of the taxonomy itself, in which specific values for fields such as 'learning outcome' are mapped to appropriate values for other fields, such as 'learning activity'. A detailed comparison of the DialogPlus taxonomy with IMS Learning Design and other pedagogical taxonomies has been carried out.

6.2.2 8LEM

The 8 Learning Events Model (8LEM)[57] has been developed by at the University of Liège, Belgium. It offers a systematic typology of 8 learning events, which are richly described to include the learners' needs, types of teaching and learning interaction, and the kinds of physical and technical environment which might support them. Partly thanks to this integration of a large number of different elements, and partly thanks to its simplicity, the model has been highlighted by the UNFOLD project[58] as a potential model vocabulary for use with IMS Learning Design. At present the 8LEM descriptions have not been successfully translated into specific sequences or design structures, but a project based at the University of Ulster in Northern Ireland has begun to make progress both with using 8LEM as a staff development tool and with mapping the LEM elements to IMS learning design (Masson et al, 2006). The Ulster instantiation of 8LEM uses 30 learning activity verbs, similar to those used in Bloom's taxonomy but with the benefit that they are not ordered hierarchically so all 8 Learning Events are treated as having equal value. Icons of the 8 Learning Events are used in staff development activities, making this a prototype visual language as well.

6.2.3 LearningMapR

LearningMapR was developed at the University of Waterloo[59] and adopted as a component of the WCKER project[60]. WCKER is a wizard extension to RELOAD[61], a tool for the creation of IMS Learning Designs, and is intended to add pedagogic guidance to what is still essentially an editing tool. There

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[55] see for example http://www.nwlink.com/~donclark/hrd/bloom.html
[56] DialogPlus- Digital Libraries in Support of Innovative Approaches to Learning and Teaching in Geography: http://www.dialogplus.org/
[57] http://www.unfold-project.net/providers_folder/providers_resources/LEM/8LEM
[58] http://www.unfold-project.net
[59] http://lt3.uwaterloo.ca/innovation/ldrg.html
[60] http://wcker.conted.ox.ac.uk/
[61] http://www.reload.ac.uk/

are two core components to LearningMapR. The first helps teachers to identify cognitive learning objectives, based on Bloom's taxonomy. Objectives are then classified on a scale from simple to complex and from factual to conceptual. The second component helps teachers to identify what kind of teaching challenge they face in delivering these objectives, again using a simple classification system (though this vocabulary lacks Bloom's basis in educational theory or proven usage). There is a direct mapping from teaching challenges to potential teaching and learning strategies, again according to a simple typology developed for the purpose.

6.2.4 AUTC Learning Design Framework

The Smart Learning Design Framework[62] incorporates the AUTC sequence representation and is based at the University of Wollongong, Australia (see also section 4.7 & 5). This project has developed a number of exemplary learning designs based on acknowledged good practice. Some of these designs appear to be generic or potentially generic, for example 'contested knowledges', 'predict-observe-explain', but the majority are specific instances of disciplinary practice and there is no actual typology associated with the designs that have been gathered. However, a graphical representation of each design in terms of how tasks, content resources and support mechanisms are deployed might be useful for bridging the gap between integrated/pedagogically rich representations, and disaggregated/technically formal representations.

6.2.5 Learning Activity Management System (LAMS)

LAMS[63] does not implement the IMS Learning Design specification directly, but it is a widely-used learning design system that claims to have been 'inspired' by the IMS specification and the work that informed it. LAMS is both a design and a run-time environment. Practitioners use a GUI to design sequences of learning activities, made up of generic activity types (presented as icons) which are populated with content to support specific topics and/or tasks. Completed designs can be run with learners, and shared with other LAMS users via the LAMS Community[64] repository. The LAMS system incorporates both a highly controlled visual vocabulary of activity icons, and the use of natural language to describe the designs that have been uploaded into the repository (via keywords). At a later time, analysis of these keywords may allow a more formal vocabulary to emerge. The LAMS system and LAMS community have been subject to intensive interest and evaluation: it is interesting to note that while both are seen in a very positive light by users, there is little evidence of generic 'patterns' of activity emerging from the repository of runnable design, nor of any demand for them on the part of users (James Dalziel, personal communication).

6.2.6 Sharing the LOAD LD taxonomies (IMS based)

This JISC project has analysed 101 learning objects from the RLO-CETL, UCeL and SONET repositories, and developed a classification of their pedagogical attributes based on features identified as significant by their users. Twelve key attributes have been identified, and these have been mapped to fields in the IMS LD framework. Rather than using controlled vocabularies to classify designs, this project has taken the approach of scoring designs against the attributes identified. This is of interest as an alternative approach, though it may be argued that it sacrifices descriptive power for the simplicity of its data model. It also assumes that the attributes identified in the survey represent universal pedagogical values, and that metadata authors are capable of making judgements about specific designs based on these criteria.

6.2.7 Shuell's Learning Functions/Learning 2 Learn

The Shuell (1992) framework was developed in collaboration with teaching staff to help them express their pedagogic designs in a way that could be shared with others, and embedded with learning objects as part of the associated metadata. The twelve functions – summarised by L2L as 'prepare – teach – review' – are in fact teaching rather than learning activities, but despite mirroring teachers' articulated practice very closely they proved challenging to use. The project team noted that '*the completion of the metadata record (including the Shuell analysis) is an example of trying to impose a*

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62 http://www.smartinternet.com.au/SITWEB/research/proj.jsp?id=15
63 See: http://www.lamsinternational.com/
64 See: http://lamscommunity.org/

method for creating a formal expression of a form of knowledge (practical knowledge) which may not easily translate to this particular formalism' (Brosnan 2006). They concluded that any vocabulary used by practitioners must be 'authentic', and that visual design support mechanisms might avoid some of the difficulties presented by formalisation of terms in a controlled vocabulary..

6.2.8 DELTA

The DELTA project[65] arose from a theoretical project on models of learning, and accordingly is based on an ontological representation of the learning domain. A structured set of vocabularies is used to help practitioners define their design context, decide on a suitable pedagogic strategy, and search for case studies and other relevant support materials. The ontology is of particular interest because it is (a) based on a number of proven theoretical models, including a typology of approaches to learning developed by Fowler and Mayes, (b) systematically structured, using semantic web technologies, though the structure is principally hierarchical and so does not allow for different approaches to and priorities within the design process, (c) fully implemented in a technical decision-support system which is both open and flexible, and uses the OWL ontology language.

6.2.9 Phoebe

This pedagogical planner project[66] initially planned to use a series of controlled vocabularies developed by Beetham (2005) from work funded under the JISC Design for Learning programme. The vocabularies support a specific domain model in which theoretical approaches, learning outcomes, activities (and sequences of activity), technologies used and learners' needs are linked in pedagogically meaningful ways. While technical implementation proved surprisingly tractable, workshops with the domain map revealed that practitioners struggled with its complexity. The cognitive and time overheads were seen as prohibitive, and while practitioners generally recognised the 'scientific' terms they were offered for their design practice, they found it difficult to re-concretise and apply them to support the design process (Liz Masterman, personal communication 08/03/07). However, the Phoebe planner does use elements of the original vocabularies to structure its guidance materials. For example, there are pages that map technologies to tasks – in both directions ('What technology can I use for doing this?' 'What is this technology good for?') – using the taxonomy of activity types and a number of associated terms. In addition, while questioning whether theoretical approaches to learning can usefully be rendered as sequences, the Phoebe team have developed a shorthand notation for sequences of tutor and student activity that help to bridge the gap between technical use cases and theoretical expressions of pedagogical purpose. The developers of Phoebe question the use of controlled vocabularies to structure runnable learning activities but suggest 'that controlled vocabularies may function the most effectively as mediating artefacts: tools for negotiating and aligning understandings.' (Masterman, ibid).

6.3 Conclusions

6.3.1 Two approaches to developing pedagogic vocabularies

It appears that two divergent approaches are being taken to the development of pedagogic vocabularies and taxonomies. The first could be called the *integrated typology* approach: the second relies on *multiple vocabularies* which may or may not have formal relationships defined between them (e.g. hierarchical/taxonomic, networked or object-oriented/ontological). Table 25 summarises the features of these two approaches.

Integrated typology	Multiple vocabularies
Small number of learning activities, events or scenarios are defined	Large number of elements defined
A single, complex typology: types are richly	A number of (related or unrelated) vocabulary

[65] See: http://www.essex.ac.uk/chimera/delta/
[66] http://phoebe-project.conted.ox.ac.uk/

described	lists
Pedagogic meaning is integrated into the typology	Pedagogic meaning resides in a secondary representation, e.g. a mapping of related terms, a separate ontology
Typology tends to be finite, claiming to describe the totality of educationally meaningful possibilities	Vocabulary lists tend to be extensible, as new terms come into use
Based on clearly espoused educational theory or model	Offer 'neutral' framework within which wide range of pedagogic (and pedagogically meaningless) approaches are possible
May be developed 'top down' from the relevant theory/ies or model/s	May be developed bottom up by gathering incidents of use, consulting with users etc.
Laurillard, 8LEM	DialogPlus, ReLOAD
DELTA, Phoebe Pattern languages? LADIE use cases?	

Table 25. Features of two approaches to pedagogical modelling by controlled vocabularies

IMS LD itself, and models based on it, use the multiple vocabularies approach. A learning design is disaggregated into a bundle of features, to some of which a controlled vocabulary can be assigned – often this is very limited e.g. two role-types (staff and learner), three fully specified services (email, conference and search-by-index). Although levels B and C of IMS LD allow logical statements to be made about the relationships of features and the values within them, the number of possible combinations is too large to allow for all of them to be modelled in a meaningful way. Instead, the LD community has taken the route of identifying instances of 'good design' (use cases, narratives) without attempting to explain which values or combinations of values make for 'goodness' in a pedagogical sense. The vocabularies used can be extensible because they are not constrained to a specific theoretical model. Indeed this neutrality with respect to theory is an essential part of the IMS LD philosophy, inherited from EML. Vocabularies are typically implemented as drop-down lists in a LD or metadata editor, or as icons in a graphical learning flow.

A limitation of this approach is discovered as soon as one tries to use an editor such as ReLOAD to write pedagogically meaningful designs. In education, some alternatives – for example whether an activity is carried out alone or in collaboration with other learners – have profound implications for every other aspect of the design process. In fact this is true of *most* alternatives. There are only a limited number of combinations of the domain model elements that make pedagogic sense. If each element has its own controlled vocabulary there is bound to be a great deal of redundancy in the overall domain map and enormous complexity involved in modelling from it.

This complexity could be managed in a hierarchical fashion if the design process could always begin from the same issue and proceed through others in a regular fashion – DELTA takes this approach; the IMS LD Best Practice guidelines also recommend a fixed procedure starting with the structure of the activity sequence and populating this with acts and role-parts. However, most practitioners arrive at a (usually provisional) structure as an end-point of the design process, with learning outcomes as the key determinant of the overall design. And despite the emphasis on learning outcomes in the guidance literature, designers may quite properly prioritise other issues, such as the teaching challenges faced (LearningMapR), the values they wish to foster (Sharing the LOAD), or learners' individual needs.

Although representations based on multiple vocabularies can be shared between different systems relatively effectively, their pedagogic meaning resides in a secondary representation – a set of comments in a user forum or repository, a use case, a good practice guide or a separately maintained ontology, as in the case of DELTA. This allows for different versions of 'good practice' to be developed, and for any version to be adapted and updated without changing the underlying vocabulary elements. Arguably, systems based on this approach make too many demands on users' time and rely too heavily on tacit pedagogic expertise on the part of the user.

Some of the most widely used educational vocabularies are in fact simple typologies, such as Laurillard's and Bloom's. These offer a small number of richly described 'types' in which several fields of description are integrated. Laurillard describes types of technology or 'media' in a way that incorporates not only technical format and delivery mode but the 'affordances' that these have for different kinds of learning experience, while 8LEM describes learning events in a way that incorporates learner and teacher activities, as well as aspects of the physical and technical environment. Such typologies are usually developed from the top down to fit a specific theoretical model of the learning process, but they seem ironically to be better accepted by practitioners than the more open-ended, 'pedagogy free' vocabularies.

Such typologies are, however, difficult to implement technically. Generic types of learning activity or event must be instantiated in a specific system, with specific content, before they can actually be delivered to learners. Hence they may be most valuable as guidance tools for the design process and for the sharing of existing designs (representation for inspiration). Intermediate forms between the practitioner-oriented typology and the runnable specification might include pattern languages, generic practice models (or events), or use cases if these were open to classification or typological analysis. Indeed, discussion at a recent UNFOLD conference concluded that to develop a usable editor/player for the LD specification it may be necessary to bundle activities into a small number of types, or even to develop separate editors for different kinds of design. We can speculate that these editors will find different points of balance between the use of multiple vocabularies and rich typologies.

The multiple vocabulary/rich typology distinction may mirror the distinction made in section 2.2 between learning designs as technical instantiations of a learning activity (machine-runnable), and learning designs as representations that support the process of design itself (inspirational). A second and related distinction could be made between loosely and tightly constrained designs, i.e. between designs where learners' activities are carefully structured and scaffolded ahead of time, and designs where learner activity emerges in response to a fairly open-ended task. Again, the 'right' solution may be context dependent. Some disciplines and educational contexts demand more didactic pedagogies, based around the mastery of already-highly-structured concepts, rubrics, and tools.

These two distinctions are explored in table 26 below.

	Runnable learning designs	Representations of learning design (process and outcomes)
Audience/users	Generally for use by learners (with support and guidance)	Generally for use by practitioners (with support and guidance)
If highly structured	Support for scaffolded activities, learning of core skills, rubrics or concepts	Support for sharing, adaptation and re-use of designs; development of design rubrics
If open in structure	Support for inquiry-based, research-based, creative and student-led activities – activity structure is emergent	Support for reflection on and discussion of the design process and its outcomes
How could this be contextualised and enriched?	The learner portion of the activity, i.e. what really happens (what use learners make of a given task) could be recorded (e.g. usage logs, process capture, outcomes etc).	Reflections from practitioner users/re-users could be recorded in the form of comments, ratings, tags
What would a generic form look like?	An activity/design 'shell' into which teachers – or learners – could import content. A generic (e.g. LAMS) sequence.	A 'pattern', a generic approach or 'practice model', a design type within a typology
What role for controlled vocabularies?	Searching and browsing for runnable designs	Searching and browsing for design ideas and guidance Negotiating and aligning understandings of the design process
What role for structured vocabularies?	Supporting adaptation of designs (including at run-time) to learner	Pedagogical planning?

	requirements and situational factors?	

Table 26: a reprise of the distinction between runnable and inspirational representations

6.3.2 Couplings and constraints

Rather than a set of practice models as de-contextualised designs, which have little support from practitioners, we have arrived at the need for a detailed domain model (see also section 2). We have asked:
What elements need to be represented in the domain model? To what extent can controlled vocabularies support their representation?

We now need to ask:
What elements need to be related within the domain model?
How should these relationships be expressed? E.g. using multiple structured vocabularies, rich typologies, or graphical workflows and other modelling techniques?

It is apparent that some elements of the domain are related in ways that are ***pragmatic, technical, or administrative***. For example,:
Locations (real and virtual) *constrain* technologies/services available. The exact relationship may be globally or locally determined, e.g. by issues of room allocation or local infrastructure
Timings *are constrained across* roles. There is a pragmatic need to coordinate learners with other learners, teachers, support staff, mentors and others involved in their learning: even asynchronous learning requires co-ordination, just over a longer time-frame e.g. a week.
Resources consumed by an activity (including staff and learner time) *are constrained by* resources available *and by* other demands on those resources

A good learning design system or protocol would address these issues ahead of time, ensuring that all the pragmatic, technical or administrative constraints were taken into account and allowing learners and teachers to focus on the pedagogic issues. Learning design, including the MOT+ editor, is making progress towards this goal, using graphical workflows coupled with controlled vocabularies (often consisting of just a couple of items).

However, there are other elements whose relationships are ***pedagogic*** rather than pragmatic. They are less a matter of constraint than of recommendation. For example:
Learning outcomes *should be closely related to* learning activities (Bloom) *and to* assessment criteria
Certain learning activities *are better supported by some* technologies; likewise certain technologies *lend themselves to* certain learning activities (Laurillard, Phoebe);
Learner needs/challenges *should help to determine* teaching approaches/strategies (LearningMapR, 8LEM)
Learner needs *should help to determine* the support that is available
Topic, topic structure and type of knowledge *should determine the* learning resources used (largely determined by discipline)
Some pedagogic couplings are very dynamic, and those relating to learners, their needs and (mis)conceptions often emerge only as an activity is undertaken. Rich typologies seem best suited to expressing these relationships. Given the positive findings on the use of 8LEM beginning to emerge from the Ulster programme, mapping the 8 learning events to Laurillard and Bloom may turn out to be the most practitioner-friendly approach to the development of a manageable vocabulary of learning design types.

	IMS?	Generic learning activity	Generic learning outcome	Technology used (system/service)	Other features of learning environment	Learning/teaching approach	Participant characteristics
Bloom	N/A	Implicitly, activities are very closely matched to outcomes	Hierarchical 'taxonomy of learning outcomes' organised according to cognitive complexity (in the cognitive domain). Widely used and adapted, especially in revised form[67]				
Laur'd	N/A	Implicitly, generic types of activity are afforded by generic media.		Typology of 'educational media'. Widely used and adapted. Media are defined not in technical terms (cf Sharing the LOAD) but in terms of their educational affordance i.e. this is a vocabulary in which educational meaning is already integrated.			
Dialog +	Yes	'Task type' and 'technique': also 'Assessment' and 'Sequence'.	'Aims' 'Outcomes' (based on Bloom)	'Tools' (based on Laurillard)	'Resources'	'Approach' – not a discrete typology but a set of three axes: reflection-non-reflection, experiential-informational, and	'Roles' 'Interaction'

[67] http://coe.sdsu.edu/eet/Articles/bloomrev/index.htm

						individual-social	
DELTA	No	'Generic learning task' 'Generic learning activity'	'Competence'??	'Tools' for Teaching, Learning and Assessment 'Other Resources'	'Physical environment' i.e. location Aspects of the 'educational environment' (context): mode, subject, sector and prerequisites for study.	'Approach' Also 'Theory'	'Roles' 'Teaching operations' = activities carried out by the teacher rather than the learner 'Student characteristics' are included as an aspect of the 'Educational environment' 'Generic learning relationships' (e.g. one to one) are included as an aspect of the 'Social environment'
8LEM	No	'Learning event'	'Domains of learning' are described for each generic event but no restricted vocabulary offered (loosely based on Bloom and Gardner?)	'Media' are to be defined for each instance of a generic event, but no media are associated with generic events and no restricted vocabulary is offered.	'Learning places' are described for each generic event but no restricted vocabulary offered	The learning/teaching approach is subsumed into the category of learning event – each event is an enactment of a particular approach to learning.	The teacher and learner 'role' are defined by the event, doing away with the need (implicit in other models) to map specific roles onto specific types of activity. Events may be individual or collaborative.
LearningMapR	Yes	'Task' uses the same vocabulary as (and is explicitly mapped to) Outcome.	'Outcome': references both Bloom and the IMS Reusable Definition of Competency or Educational Objective specification		Topic	A restricted vocabulary (typology) for the type of 'challenge' faced by the teacher in teaching this topic.	A restricted vocabulary (typology) for 'tutoring and teamwork strategy', matched with the type of 'challenge' identified.

			(RDCEO, V 1.0)				
LAMS	Yes?	'Activity' (graphical icons)		'Activity' and 'Tool' are identical: within the LAMS system, learners use LAMS tools to carry out specific activities (e.g. 'chat').			
Phoebe	No?	'Activity' and 'Technique' with controlled vocabularies suggested. Features of the sequence itself including timing and contingency plans.	'Aims' (course level) and 'Intended learning outcomes' (unit level) with controlled vocabularies suggested	'Technology' and 'Resources' with controlled vocabularies suggested.	'Social composition', 'Role of teacher', modes of 'Assessment' and 'Feedback', with controlled vocabularies suggested.	An extensible vocabulary mapped to Mayes and de Freitas' typology of learning approaches.	'Staff' and their 'Roles', 'Learner characteristics' with controlled vocabularies suggested.
Sharing the LOAD	Yes	'Activity'	There is no vocabulary for 'objective', only a score as to how well it matches the activity.	Described in purely technical terms (cf. Laurillard) i.e. the delivery format (text, audio etc).	Again no vocabulary but a set of desirable features against which the offered tool/resource/service is scored: Interactivity, Integration, Context, Richness, Pre-requisites, Support, Feedback, Self-direction, Navigation, Assessment, Alignment		'Roles'

Table 27. A comparison of the elements included in a range of structured vocabularies for use in education, based on the elements of a learning design identified by Currier et al (2005)

Bloom	Remember Understand Apply Analyse Evaluate Create	Cognitive dimension only, as revised at http://coe.sdsu.edu/eet/Articles/bloomrev/index.htm
Laur'd	N/A	
Dialog+	Knowledge Comprehension Application Analysis Synthesis Evaluation	Based on Bloom's cognitive dimension
DELTA	Acquire knowledge Acquire skills Reflect critically Gather facts Solve problems Expose to concepts Engage in discussion Build theories Evaluate	Based on Fowler and Mayes (1999)
Learning MapR	Based on Bloom	
Phoebe	Based on Bloom	
8LEM	creates debates experiments explores imitates metalearns practices receives	
Sharing the LOAD	MCQ Answer Selection Drag and drop Text entering Image selection Image manipulation	These are activities of learners as users interacting with a virtual learning system. Note that each user/system activity defined here might be undertaken in the course of any of the learning activities described in other models, i.e. there is no obvious correlation between the educational meaning of the activity and the system interactions required.
LAMS	Group Poll Chat Chat and scribe Share resources Forum Resources forum Question and Answer Noticeboard	Activities define users' interactions with one another via the system (cf Sharing the LOAD), but are still some way removed from the 'pedagogically meaningful' activities that lead clearly to specific learning outcomes.

Table 28. A comparison of the learning outcome/activity vocabulary elements of the different structured vocabularies

I	Instantiation: Timing, sequence, case studies, teaching tips, teacher reflection	Few vocabularies available. Timing and sequencing issues dealt with in IMS LD using discrete fields (e.g. start/stop triggers) – more obviously represented using sequential format (see section 5). Some attempts to typologise case studies (e.g. DELTA).
A	Adaptability: Alternative tools, activities, approaches, resources, granularity	'Tools' vocabularies available in most of the projects investigated, but little convergence (see Environment below). 'Activities' vocabularies dealt with in table xxx above. Some restricted vocabularies available to describe types of resource e.g. SeSDL, DialogPlus (based on SeSDL).
O	Pedagogy: Approach, aims, issues, problems, assessment modes	Largely dealt with in table xxx above. Restricted vocabularies are difficult to apply as the area is rich in complex and overlapping theories, and different theoretical perspectives imply different typological divisions of the field. None are uncontested: Mayes and de Freitas' typology has been well received in the UK. Most projects have developed vocabularies for assessment mode, e.g. SeSDL, DialogPlus, Phoebe: again there is little convergence (FREMA[68])
D	Discipline: Discipline, subject, content, learning outcomes	Several vocabularies for discipline/subject area available in the UK. Some disciplines/subject areas have stable topic vocabularies. Learning outcomes dealt with in table xxx above.
E	Environment: Physical environment, learning environment tools/technology, delivery mode	'Tools' vocabularies available in most of the projects investigated, but little convergence. Some describe delivery media, some describe software/platforms used for delivery, and some describe pedagogical function (e.g. Laurillard).
Au	Audience: Level, learner characteristics, class size, accessibility	Several vocabularies for educational level available for use in the UK. Learner characteristics rarely described: could be dealt with by linking to individual learner records at run time?
Q	Quality: Peer review, student feedback, student outcomes, ranking, date of publication	No vocabularies available.
OF	Operational Factors: Cost, time, support/resources required	No vocabularies available

Table 29. Elements identified as necessary by practitioners on the Mod4L project, mapped to vocabularies available/in development

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8 Appendices

8.1 Appendix 1: Mod4L Focus Group members

Name	Discipline	Institution	HE/FE
Simon Bates	physics	Edinburgh	HE
Angela Benzies	engineering	Napier, Edinburgh	HE
Douglas Chalmers	economics	Glasgow Caledonian	HE
Liz Foulis	art & design	Lauder College	FE
Kate Lennon	business	Glasgow Caledonian	HE
Gavin Heron	social work	Strathclyde	HE
Julie McCran	Management/	Telford College, Edinburgh	FE
Isobel McKay	science	Lauder College	FE

Elaine Smith	engineering	Glasgow Caledonian	HE
Keith Smyth	online learning	Napier, Edinburgh	HE
David Young	cabinet making	Lauder College	FE
Mel Cadman	social work	Strathclyde	HE
Chris Pegler	Learning technology	Open University	HE
Helen Walmsley	Learning technology	Staffordshire University	HE

8.2 Appendix 2: Examples of generic learning designs

8.2.1 Designs derived from Mod4L & LADIE projects

These generic designs were abstracted from designs contributed by Mod4L participants, and from the LADIE project use cases (http://www.elframework.org/refmodels/ladie/ouputs/usecases/). Note that the original Mod4L and LADIE designs seldom articulated a single pedagogic approach – these generic designs represent the commonalities between designs that are similar in some respects though very different in others. They are represented using the form developed by Phoebe (http://phoebe-app.conted.ox.ac.uk/cgi-bin/trac.cgi/wiki/WikiStart)

Social constructivist learning design

Overview

The constructivist approach is based on the belief that that learning is an active process where learners construct new ideas based on their existing or previous knowledge and understanding. In its social constructivist form, students work collaboratively to construct new ideas.

The social constructivist approach is characterised by

In learning
Conceptual development through integration of ideas
Collaboration with other students
Ill-structured problems
Opportunities for reflection
Ownership of the task

In teaching
Provide interactive environments and appropriate challenges
Encourage experimentation and the discovery of broad principles
Coach and model thinking skills
Frame learning outcomes in meta-cognitive terms to encourage the development of autonomy

In assessment
Conceptual understanding (applied knowledge and skills)
Extended performance
Processes as well as outcomes
Crediting varieties of excellence
Development of self- and peer-evaluation skills

The teacher's role

Constructivist learning is a learner-centred approach in which the student(s) take control The teacher's role is as facilitator and coach

General overview

Orientate students in relation to the topic.
Introduce the task, and check students' understanding of it
Provide support throughout task
Students perform task collaboratively
Students present outcomes of task

Peer and teacher feedback on presentation
Assess process and outcome

Guidelines for planning

- View topic of session holistically
- Decide on a collaborative task which will enable students to construct their understanding of the topic
- Decide the timescale of the task
- Decide on the form of outcome, and on how it is to be stored and accessed if used later on in the course
- Decide how to assess the process and outcomes
- Decide how you will provide learners with:
    - space and tools to collaborate and perform the task (physical or online)
    - suggested resources
    - facilities for presenting, storing and retrieving outcomes
    - support in forming groups and performing the task

8.2.2 Sequence of activities

T = Tutor; S = Students; + = Concurrent actions

			1. Orientate
T			Introduce the topic domain to the students.
			2. Carry out task
T			Describe the task, and the way it will be assessed, to the students
T	S		Check student understanding of the task
	S	+	Form groups and organise work (who does what)
	S	+	Perform task
	S	+	Create outcome of task
	S	+	Discuss and reflect on task and process
T		+	Support students throughout group formation, work planning, task performance and outcome creation
	S		Presentation of outcomes
			3. Assess and/or reflect on the task
T	S		Peer and teacher reflection/feedback on the process and outcomes
			4. Feed forward of constructed understanding
T	S		Continue discussion
T	S		Archive outcomes for future use.

Based on LADIE use cases 7, 16; Mod4L learning designs contributed by Keith Smythe, Simon Bates, Angela Benzies

8.2.3 A Case-based learning design

8.2.4 Overview

Case-based learning allows learners to develop their own conceptions of a subject area through exploring exemplary cases. Learners may work individually or in groups. They have a variable degree of control over problems and tasks.

The practice-based approach is characterised by

In learning
Development of knowledge and understanding through exploration and analysis of cases
Development of analytical skills
Discussion with peers
Opportunities for reflection
Tasks are likely to be fairly open-ended
Presentation of enhanced understanding and skills

In teaching
Provide case studies
Provide conceptual and/or analytic scaffolding to support student analysis of cases
Support student analysis and discussion
Frame learning outcomes in meta-cognitive terms to encourage the development of autonomy

In assessment
Extended performance
Processes as well as outcomes
Crediting varieties of excellence
Development of self- and peer-evaluation skills

8.2.5 The teacher's role

Case-based learning is a learner-centred approach in which the student(s) have a degree of autonomy within a framework devised by the teacher. The teacher's role is as facilitator and coach

8.2.6 General overview

Orientate students in relation to the topic.
Introduce the cases studies and conceptual and/or analytic frameworks
Provide support throughout task
Students perform task individually or collaboratively
Students discuss their performance with peers
Students present outcomes of task
Peer and teacher feedback on presentation
Assess process and outcome

8.2.7 Guidelines for planning

- View topic of session holistically
- Decide on a case study/studies that will allow students to enhance their understanding and skills
- Decide on the conceptual and/or analytic framework which the students will use
- Decide the timescale of the task(s)
- Decide on the form of outcome, and on how it is to be stored and accessed if used later on in the course
- Decide how to assess the process and outcomes
- Decide how you will provide learners with:
    - Access to case studies and tools to perform the task (physical or online)
    - Discussion space
    - facilities for presenting, storing and retrieving outcomes
    - support in performing and discussing the task

8.2.8 Sequence of activities

T = Tutor; S = Students; + = Concurrent actions

	1. Orientate
T	Introduce the topic domain to the students.
	2. Carry out task
T	Describe the case study, and the way it will be assessed, to the students
T	Introduce important conceptual and/or analytic frameworks

T S Check student understanding of the task, and frameworks
T S Check student access to case studies
S + Explore and analyse case study, drawing on frameworks
S + Reflect on task and process with peers
S + Create outcome of task
T + Support students throughout case study analysis and outcome production
S Presentation of outcomes

3. Assess and/or reflect on the task

T S Peer and teacher reflection/feedback on the process and outcomes

4. Feed forward of practice

T S Archive outcomes for future use.

Based on LADIE use cases 4, 14; and Mod4L learning designs by Gavin Heron, and Keith Smythe

8.2.9 A Practice-based learning design

8.2.10 Overview

Practice-based learning requires that students perform a practical task, reflect upon their performance of the task (possibly with their peers), and experiment, modify and develop their performance in the light of experience.

(The process is similar to Kolb's experiential learning but lacks the emphasis on abstraction and testing of generalised ideas. Instead the focus is on developing practical skill.)

The practice-based approach is characterised by

In learning
Development of performance through reflection and experiment
Discussion with peers
Opportunities for reflection
Open-ended tasks
Tasks of increasing complexity

In teaching
Provide tools, resources, interactive environments and appropriate challenges
Encourage experimentation and reflection
Frame learning outcomes in meta-cognitive terms to encourage the development of autonomy

In assessment
Extended performance
Processes as well as outcomes
Evidence of reflection
Crediting varieties of excellence
Development of self- and peer-evaluation skills

8.2.11 The teacher's role

Practice-based learning is a learner-centred approach in which the student(s) have a degree of autonomy within a framework devised by the teacher The teacher's role is as facilitator and coach

8.2.12 General overview

Orientate students in relation to the topic.
Introduce the task, resources and tools, and demonstrate their use

Provide support throughout task
Students perform task individually or collaboratively
Students discuss their performance with peers
Students present outcomes of task
Peer and teacher feedback on presentation
Assess process and outcome

8.2.13 Guidelines for planning

- View topic of session holistically
- Decide on a task or sequence of tasks which will enable students to develop their practice
- Decide the timescale of the task(s)
- Decide on the form of outcome, and on how it is to be stored and accessed if used later on in the course
- Decide how to assess the process and outcomes
- Decide how you will provide learners with:
  - Space, resources and tools to perform the task (physical or online)
  - Discussion space
  - facilities for presenting, storing and retrieving outcomes
  - support in performing and discussing the task

8.2.14 Sequence of activities

T = Tutor; S = Students; + = Concurrent actions

1. Orientate

T Introduce the topic domain to the students.

2. Carry out task

T Describe the task, and the way it will be assessed, to the students
T Demonstrate use of the tools
T S Check student understanding of the task
T S Check student access to tools
S + Perform task and create outcome
S + Reflect on task and process
S + Vary practice (possibly several times) and create new outcome(s)
S + Reflect on variations
S + Discuss practice and variations with peers
S Develop practice
S Produce final product or outcome
T + Support students throughout task performance and outcome creation

3. Assess and/or reflect on the task

T S Peer and teacher reflection/feedback on the process and outcomes

4. Feed forward of practice

T Introduce more complex task
T S Archive outcomes for future use.

Based on LADIE usecase 12; and Mod4L learning designs by Liz Foulis, and Stephen Woulds

8.2.15 A Reflective learning design

8.2.16 Overview

In Reflective learning students reflect upon their learning, to understand their own learning processes and thus allow them to become more autonomous. The process is based on Kolb's learning cycle and is expected, ultimately, to be cyclical, going through stages of experience, observation, reflection, planning, further experience and so on. However, many learning designs encompass only one cycle.

The reflective approach is characterised by

In learning
Focus on active learning through individual experimentation or through peer exploration and discussion
Opportunities for reflection
Open or closed tasks

In teaching
Provide tools, resources, interactive environments and appropriate challenges
Encourage reflection, discussion and/or experimentation
Frame learning outcomes in meta-cognitive terms to encourage the development of autonomy

In assessment
Extended performance
Processes as well as outcomes
Evidence of reflection
Crediting varieties of excellence
Development of self- and peer-evaluation skills

8.2.17 The teacher's role

Reflective learning is a learner-centred approach in which the student(s) have a degree of autonomy within a framework devised by the teacher The teacher's role is as facilitator and coach

8.2.18 General overview

Orientate students in relation to the topic.
Introduce the task
Provide support throughout task
Students perform task individually or collaboratively
Students reflect on their skills, understanding, knowledge and learning throughout task
Students discuss their understanding, etc with peers
Students present outcomes of task
Peer and teacher feedback on presentation
Assess process and outcome

8.2.19 Guidelines for planning

- View topic of session holistically
- Decide how to encourage student reflection
- Decide on a task or sequence of tasks which will enable students to develop their knowledge and understanding
- Decide the timescale of the task(s)
- Decide on the form of outcome, and on how it is to be stored and accessed if used later on in the course
- Decide how to assess the process and outcomes
- Decide how you will provide learners with:
    - Space, resources and tools to perform the task (physical or online)
    - Opportunities for reflection
    - Discussion space
    - facilities for presenting, storing and retrieving outcomes
    - support in performing and discussing the task

8.2.20 Sequence of activities

T = Tutor; S = Students; + = Concurrent actions

		1. Orientate
T		Introduce the topic domain to the students.
		2. Carry out task
T		Describe the task, and the way it will be assessed, to the students
T	S	Initial student reflection on knowledge and understanding necessary for the task
T	S	Check student access to resources
	S +	Perform task
	S +	Create outcome of task
	S +	Reflect on task and process individually or with peers
	S +	Plan improved performance or further exploration of task
	S +	Produce product or outcome
T	+	Support students throughout task performance and outcome creation
	S	Presentation of outcomes
		3. Assess and/or reflect on the task
T	S	Peer and teacher reflection/feedback on the process and outcomes
		4. Feed forward of practice
T		Introduce more complex task
T	S	Archive outcomes for future use.

Based on LADIE use cases 1, 11, 15

8.2.21 A Cognitive scaffolding design

8.2.22 Overview

Cognitive scaffolding provides a framework that helps the learner to organize prior knowledge and internalize new information. The teacher collaborates with students in activities that are just outside what they could achieve on their own. Once the student has reached the new level of understanding the scaffolding can be removed. Scaffolding might include models, cues, prompts, hints, partial solutions, think-aloud modelling and direct instruction

The practice-based approach is characterised by

In learning
Development of conceptual understanding through structured activity
Discussion with peers
Opportunities for reflection
Whole task broken down into smaller tasks

In teaching
Provide scaffolding tasks
Provide (access to) information resources
Feedback on tasks
Encourage discussion and reflection
Frame learning outcomes in meta-cognitive terms to encourage the development of autonomy

In assessment
Extended performance
Processes as well as outcomes
Representation and/or reinterpretation of content

8.2.23 The teacher's role

Cognitive scaffolding is a learner-centred approach in which the student(s) have a degree of autonomy within a framework devised by the teacher   The teacher's role is primarily as coach

8.2.24 General overview

Orientate students in relation to the topic.
Introduce the whole task, and the scaffolding tasks
Provide support throughout task
Students perform tasks individually or collaboratively
Students discuss their performance with peers
Students present outcomes of tasks
Teacher (and peer) feedback on presentation
Assess process and outcome
Students undertake more complex tasks

8.2.25 Guidelines for planning

- View topic of session holistically
- Decide on a task or sequence of tasks which will enable students to develop their understanding of material
- Decide on information resources
- Decide the timescale of the task(s)
- Decide on the form of outcome, and on how it is to be stored and accessed if used later on in the course
- Decide how to assess the process and outcomes
- Decide how you will provide learners with:
    - Space, resources and tools to perform the task (physical or online)
    - Discussion space
    - facilities for presenting, storing and retrieving outcomes
    - support in performing and discussing the task

8.2.26 Sequence of activities

T = Tutor; S = Students; + = Concurrent actions

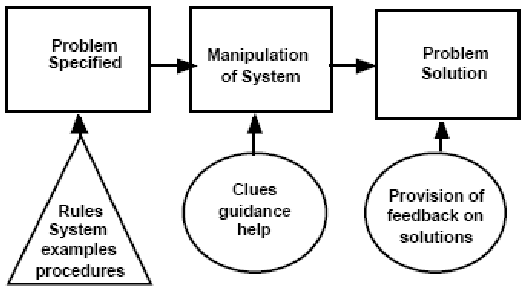
		1. Orientate
T		Introduce the topic domain to the students.
		2. Carry out task
T		Describe the task, and the way it will be assessed, to the students
T		Provide students with (access to) information resources
T		Describe the component tasks (and the way they will be assessed)
T S		Check student understanding of the task(s)
S	+	Perform component tasks and create outcome
S	+	Reflect on and discuss tasks and process
T	+	Support students throughout task performance and outcome creation
S		Produce product or outcome for whole task
		3. Assess and/or reflect on the task
T S		Teacher (and peer) reflection/feedback on the process and outcomes
		4. Feed forward of practice
T S		Archive outcomes for future use.
T		Introduce more complex task

Based on LADIE use cases 2, 7, 10; and Mod4L learning designs by Gavin Heron

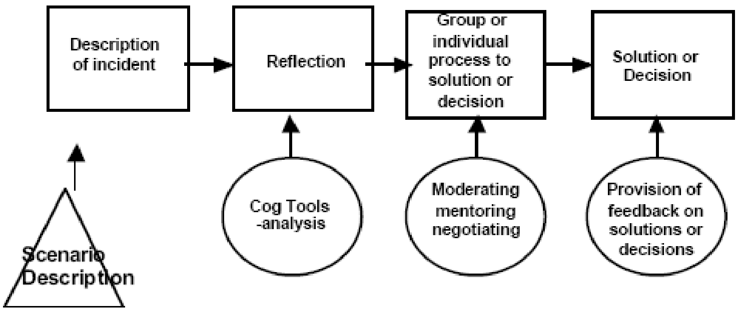
8.2.27 Four problem-based designs from the AUTC project

The AUTC project identified four basic structures of problem-based learning designs and represented them in an early form of the AUTC temporal sequence system (Oliver et al 2002)

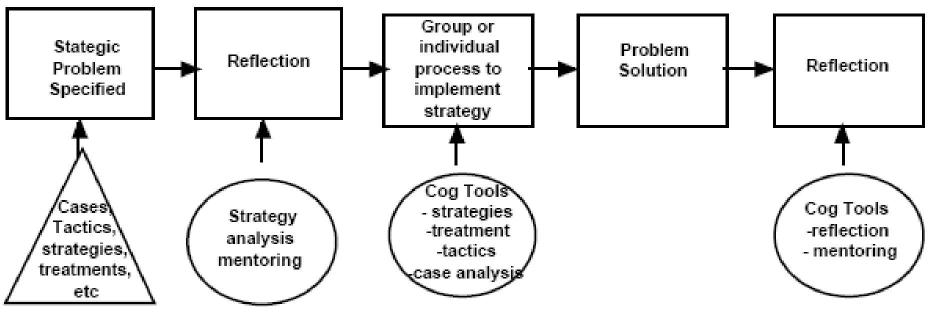
A rule-based design:



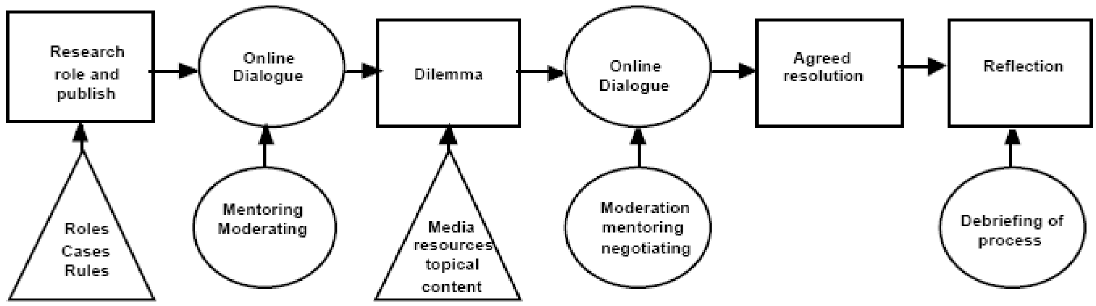
An incident-based design:



A strategy-=based design:



A role-based design:



8.2.28 Generic designs mapped against pedagogic approach and priority (Beetham 2005)

Mapping table B is used to decide on a sequence of tasks and, where appropriate, the locus of control for each task, i.e. whether the tutor, learner, or peer learners are primarily responsible for managing each task.

First two rows: all approaches
All approaches have certain tasks in common, which (if carried out by the tutor) may be seen as general administrative or class management tasks. However, if carried out by the learner(s), these integrative tasks can themselves have an important learning function. For this reason, integrative tasks may actually constitute a sequence in themselves, e.g. where a learning session such as a tutorial or guidance meeting is focused on planning and self-evaluation, or where meta-cognitive (learning-to-learn) skills are the primary learning outcome.

Next section: by approach
This uses the range of 'approaches' identified in Mapping Table A.

Final section: by priority
It is possible to skip the 'approach' altogether and determine appropriate sequences directly from the priority for learners. This section could then be seen simply as an extension to Mapping Table A. This is the preferred method of using the tables because:
It cuts out one complete table
Many practitioners are unfamiliar with the different 'approaches', do not plan their teaching on the basis of 'approach', or make use of different approaches without using these terms to describe them.
Describing an approach in terms of a particular sequence of activity is necessarily contentious, and may be resisted by the developers and promoters of this approach.
There are multiple overlaps and redundancies among the different approaches (and many other approaches which could have been included here)
In contrast, the 'priorities' seem on early consultation to represent a fairly complete picture of the range of possibilities considered by practitioners
The suggested sequence for each priority represents a summation of the relevant approaches – thus reducing redundancy and complexity still further.

- Mapping B: pedagogic approach to suggested sequences of activity

• **All approaches** (integrative activities)	• Integrative activities are often carried out by tutors or other learning professionals, but may be carried out by peers or by self-directed learners. • • Planning and reflection/review may be carried out by the tutor in tutor-led approaches, by peers in situated/participative approaches, or by the learner in constructive approaches. • • Where they are carried out by learners, integrative activities have a meta-cognitive or ‘learning to learn’ function. In this case they may constitute a complete learning scenario or sequence in their own right, leading to meta-cognitive learning gains.	• Plan • Decide goals • Decide tasks • Decide criteria for success • Acquire and manage resources • Support • Support access to resources, facilities and tools • Direct to remedial or alternative resources • Guide or model activities • Provide formative feedback • • Reflect/review • Evaluate learner outcomes against criteria • Evaluate task performance • Review learner goals
• All collaborative approaches (integrative activities)	• In addition to the above, collaborative approaches involve further integrative activities. Again, they may be carried out by the tutor or by learners themselves. • • Again, if carried out by the learner, these integrative activities in may constitute a learning approach or sequence in their own right, leading to meta-cognitive learning gains. See ‘dialogue’ and ‘argumentation’ in the left-hand column for examples.	• Plan • Allocate groups • Allocate roles within groups • Support • Facilitate group process: prompt, summarise, question, clarify etc • Reflect/feedback • Evaluate group performance as well as individual performance
• By approach: associative		
• Guided instruction • Drill and practice • (Computer-based) training	• Progressive acquisition of component skills or concepts, through sequenced routines of organised activity with feedback. • • Integrative activities are carried out by tutor.	• Orientate learner in relation to target domain (concepts or skills) • Break down domain into component units • Introduce unit (content or skill) • Learners practice skill or recall content • Provide feedback on

		performance • Repeat 4-5 until performance meets success criteria • Move onto next component: repeat 3-6. • Test extended performance (full skill-set or concept group) • Take any remedial action until success criteria is met
• Instructional systems design (and associated protocols) (*e.g. Gagne*)	• As for guided instruction, with focus on appropriate instructional technique for each component unit. • • Integrative activities are carried out by tutor.	• As for guided instruction, but step (2) typically involves a hierarchical analysis of conceptual structure, with separate instructional approach for each concept.
• By approach: constructive		
• Cognitive scaffolding (*e.g. Piaget*) •	• Focus is on challenging and developing learners' conceptions through progressive conceptual tasks. • • There may be opportunities for collaboration and debate. • • Integrative activities are typically carried out by tutor.	• Situate knowledge in context of domain. • Present content (structure, sequencing, media, language must match paradigm of subject area) • Anticipate, elicit and accommodate learner misconceptions. • Explain, summarise, illustrate, answer questions. • Re-present content for different learner needs • Design and assess tasks based around interpretation and re-presentation of content
• Goal-based scenarios •	•	•
• Experiential learning (based on Kolb's learning cycle) • •	• Focus on active learning, either through individual experimentation or through peer exploration and discussion. • • Integrative activities may be directed by the tutor or progressively by the learner(s).	• Review relevant terms and concepts • Expose learner to new experience or concept • Support active observation and reflection (e.g. by structured note-taking, comprehension questions, discussion) • Learner presents new conception • Learner plans further investigation (e.g. experimentation, research) • Repeat 2-5. • Learner presents final state of conception.
• Constructivist learning	• Focus is on learner	• Scope conceptual

environments •	activity within an environment of tools, resources and services. Overall control of content remains with the tutor, but within the learning environment there is relative autonomy. • • Integrative activities generally carried out by tutor. Learner may have some direction over task goals. •	domain in terms of key issues, problems and scenarios • Represent conceptual domain e.g. through simulations, case studies • Provide tools to investigate conceptual domain (e.g. adaptive or productive) • Introduce key terms and concepts • Set investigative tasks or questions • Support learner access to environment • Provide opportunities to discuss or reflect on findings •
• Problem-based learning •	• Learners investigate specific problems and issues with access to a range of relevant content resources. • • Learners have a variable degree of control over problems set. • • Integrative tasks generally directed by the tutor but may incorporate peer feedback and discussion.	• Present problem • Learner elaborates problem (e.g. through analysis, discussion) • Provide information resources • Learner seeks information • Learner analyses and evaluates information for relevance • Learner applies information to problem • Learner presents solution(s)
• Case-based learning •	• Learners develop their own conceptions of a subject area through exploring exemplary cases. • • Learners have a variable degree of control over problems and tasks. • • Integrative tasks generally directed by the tutor but may incorporate peer feedback and discussion.	***8.2.28.1.1 Present key terms, concepts and issues*** ***8.2.28.1.2 Learner re-presents key terms etc [1 and 2 optional]*** ***8.2.28.1.3 Present or provide access to relevant cases*** ***8.2.28.1.4 Learner analyses cases in terms of key concepts*** ***8.2.28.1.5 Learner presents refined understanding of key concepts*** •
• Anchored instruction	• Case-based or problem-	• Provide ‘anchor’ (= story,

•	based learning that revolves around a pre-prepared ‘anchor’, typically a video, story or narrative case study. • • Anchor is crucial to process, typically produced by instructional design team as part of a teaching pack. Often used for basic language or mathematical learning. • • Integrative activities are directed by the tutor but may be shared with other learners, esp in discussion.	video, play, case study) • Support learner discussion and exploration • Learners identify and describe problem(s) presented in ‘anchor’ • Learners identify and share resources for solving problem(s) • Learners apply knowledge to problem(s) • Learners present solution(s) •
• Research-based or exploratory learning	• General term for learner-directed investigation, typical of higher level learning. • • Integrative tasks progressively taken over by the learner.	• Learner defines key question, hypothesis or issue • Learner defines investigative approach • Support 1 and 2 (e.g. provide information on relevant investigative processes and protocols) • Learner carries out relevant investigations • Support 4 (e.g. guide, model , suggest alternative courses of action) • Learner reports findings • Provide formative feedback on processes and findings
• Reciprocal teaching • Conversational model (Laurillard/Pask) •	• Through the learning dialogue, learners’ conceptions are progressively challenged and developed. Teaching content is adapted to learners’ needs. • • Integrative activities are directed by tutor but may be shared with learner(s). • • May be carried out with peer mentor(s) rather than tutor. Dialogue with more knowledgeable tutor/mentor is critical.	• Set task goal • Describe concept • Learner describes concept AND/OR learner performs task • Re-describe concept in light of learner action or description • Adapt task goal in light of action or description • Repeat steps 2-5 until learner and teacher descriptions co-incide.
• (Computer-supported) collaborative learning •	• Learners work collaboratively towards agreed learning goals. • • Learners may be assessed individually on	• Agree learning goals • Agree allocation of tasks • Support processes of self-assessment, negotiation and team working

	their contribution to a collective process and outcome, or may be collectively assessed. • • Focus on peer feedback and assessment.	• Support access to relevant resources, facilities and tools • ColaAgree when goals have been reached • Support process of peer evaluation and review. •
• By approach: situative		
• Apprenticeship • Cognitive apprenticeship • Situated learning • (Legitimate peripheral) participation •	• Learning is situated in an authentic work-based or learning community. • • Learning tasks are negotiated in situ. Learning takes place through informal observation and participation rather than formal instruction. • • Tutors remain responsible for feedback and assessment (though self-assessment is progressively encouraged).	• Learner introduced to context • Learner observes activity in context • Opportunities for discussion and reflection with peers • Learner participates peripherally in activity • Opportunities for feedback, discussion and reflection • Learner participates more centrally in activity • Repeat 5-6: learner becomes progressively enculturated in practice of the community • Feedback focusing on process and authenticity. •
• Critical reflection • (Continuing) professional development • Work-based learning	• As for apprenticeship: however, learner is typically already a member of the relevant community. Tasks arise in the context of an established work role and are assessed by the learner with the support of a tutor or mentor.	• Learning goals negotiated with learner • Give access to relevant professional resources and/or mentoring • Clarify alternative courses of action • Support the process of critical reflection • Support the development of specific work-related skills. • Support self-evaluation and forward planning. • Encourage and recognise achievements
• Dialogue • Argumentation •	• Learners are encouraged to develop their own opinions, values and points of view through debate with peers. • • Integrative activities and moderating roles may be directed by the tutor or progressively by learners (see in particular the 'support' activities under 'all collaborative approaches').	• Agree key topics and issues for discussion • Agree roles and rules of debate • Support and moderate discussion as appropriate • Model appropriate behaviour in discussion forum • Capture and re-present key learning events • Evaluate and reflect on process

By priority				
Priority	Example teaching activities	Actual task sequence: tutor	Actual task sequence: learner	Further reference required
Acquire knowledge (individual approach)	Orientate learner in relation to concepts	Plan		
		Decide intended outcomes		
	Break down concepts into component units			
		Decide criteria for success		
	Introduce each unit (content or skill)			
		Break down concepts into component units		
	Learners practice skill or recall content			→ Keyword search of subject-specific resources
		For each component unit		
	Provide feedback on performance	Acquire or produce appropriate narrative resource(s)		→ Mapping table C: select tasks appropriate to domain and outcome
	Repeat 4-5 until performance meets success criteria		2. Orientate	
		Decide appropriate task(s)	Apprehend (read, observe, listen etc)	→ Mapping table D: select available and appropriate tools/services
	Move onto next component: repeat 3-6.			
		2. Orientate	3. For each component unit:	
	Test extended performance (whole concept or domain)	Present narrative resource: whole domain		
			Apprehend (read, observe, listen etc)	
	Take any remedial action until success criteria is met	3. For each component unit:	Comprehension task (visualise, define, summarise etc)	
				→ Mapping table E: select assessed task and type of feedback
		Present narrative resource: component unit		
			OR	
		Present component task (e.g. comprehension)	Assessed task (MCQ, drill, problem, short answer)	
		Support and guide task		
		Feedback on task performance	Any remedial task	
		Remediate	4. Final assessed task (MCQs, problems short answers, essay)	→ Mapping table E: select assessed task and type of feedback
		4. Test extended performance		
		Present extended task: whole domain		

		• Provide feedback on extended task outcomes		
• Develop conceptions (experiential – problem or case based)	• Present issue or problem • Elicit, acknowledge and challenge learners' conceptions of problem • Provide examples, cases and other resources • Create 'safe' context for exploration • Model language and paradigm of subject area • Facilitate discussion, debate and collaboration • Prompt for analysis and reflection • Elicit new conception of issue or solution of problem • Provide feedback	• 1. Plan • Decide intended outcomes • Decide criteria for success • Choose appropriate issue or problem • Find/produce resources (a) cases, examples (b) protocols, methods • (optional) Allocate groups and/or roles • 2. Present issue or problem • Present narrative resource (speak, write, show etc) • Elicit learner conception of problem with discussion task, articulation task or questions • Feedback on learner(s) articulation of problem • Remediate misconceptions • 3. Present resources (a) cases, examples (b) protocols, methods • 4. Support	• 2. Re-present issue or problem • Apprehend (read, observe etc) • Discussion task (collaborate) • OR • Articulation task (write, speak, draw, perform, recall etc) • OR • Comprehension task (visualise, define, summarise etc) • OR • Assessed task (MCQs, short answers) • 3. Review resources • Apprehend (read, observe, etc) • 4. Use resources • Interact (investigate,	• → Keyword search of subject-specific resources • → Mapping table C: select tasks appropriate to domain and outcome • → Mapping table D: select available and appropriate tools/services

		• Support access to cases, examples • Demonstrate protocols, methods in use • Facilitate individual learning (interact, reflect) • (optional) Facilitate social learning (social task) • • 5. Assess performance • Set task • Feed back on task performance •	explore, experiment, apply method/protocol) • (optional) Social task (discussion, collaboration) • Reflect (assess, analyse, interpret, draw conclusions, solve problem) • • 4. Assessment task • Articulate • OR • Assessed task (essay, problem, report, assignment, process capture)	• • • • • → Mapping table E: select assessed task and type of feedback •
• Develop conceptions (experimental – lab or field based) •	• Offer issue, question or hypothesis • Elicit, acknowledge and challenge learners' conceptions • provide tools for research and experimentation • Create 'safe' context for exploration • Model language and paradigm of subject area • Facilitate discussion, debate and collaboration • Prompt for analysis and reflection	• 1. Plan • Decide intended outcomes • Decide criteria for success • Choose appropriate experiment or field test • Ensure safety of test environment • Provide tools for research and testing • (optional) Allocate groups and/or roles • • 2. Review • Present issue or hypothesis • Elicit learner conception of issue or hypothesis • (optional) Feedback on learner(s) articulation of	• • • • • • • • • • • • • 2. Review • Apprehend (read, listen etc) • (optional) Articulate (write, speak etc) issue or hypothesis • •	• • • • → Mapping table C: select tasks appropriate to domain and outcome • • • → Mapping table D: select available and appropriate tools/services • • • • • → Keyword search of subject-specific resources • • • •

		problem • Remediate misconceptions • 3. Demonstrate • Demonstrate protocol/method in use • 4. Support • Support access to tools and environment • Guide safe and effective application of method • Facilitate individual learning (interact, experience, record reflect) • 5. Assess performance • Set task • Feed back on task performance	• 3. Prepare • Apprehend (read, observe, listen etc) protocols for experiment or test • (optional) Practice component parts of protocol for experiment or test • 4. Experiment • (Inter)act (investigate, experiment, apply method, use instrument(s)) • Experience (see, hear, feel) • Record data • Reflect (assess, analyse, interpret, draw conclusions) • 5. Assessed task • Articulate • OR • Assessed task (project, report, assignment, practical, process capture)	• → Mapping table E: select assessed task and type of feedback
• Develop conceptions (critical – discussion- or research-based)	• Pose question or issue • Clarify assumptions, beliefs and values • Encourage and model skills of critical analysis • Offer examples and	• 1. Plan • Decide intended outcomes • Negotiate discussion or research issue • Negotiate criteria for	• 1. Plan • Negotiate discussion or research issue (also seek i.e. question, define, scope etc) • Negotiate criteria for	• → Mapping table C: select tasks appropriate to domain and outcome

	cases • Summarise differences and areas of consensus • Involve learners in designing and assessing appropriate tasks	success • Negotiate task(s) • (optional) suggest groups and/or roles • • 2. Support research or discussion • Continuously feedback on learner articulation of issue • Suggest resources for further investigation • Support individual learning (guide skills, clarify concepts) • (optional) Support social learning (summarise, facilitate, model process) • Remediate misconceptions • • • 3. Assess performance • Set task as agreed • Feed back on task performance •	success • Negotiate task(s) • (optional) choose group and/or role • • 2. Research or discuss issue • Articulate (speak, write, draw etc) = initial understanding or position on issue • Research = seek, apprehend, comprehend, apply, evaluate cycle • OR • Discuss = communicate OR collaborate OR debate, (depending on learning outcomes) • • 3. Assessed task • Articulate (= final understanding or position) • OR • Assessed task (project, report, assignment, practical, process capture)	• • • • • → Mapping table D: select available and appropriate tools/services • → Keyword search of subject-specific resources • • • • • • • • • • → Mapping table E: select assessed task and type of feedback •
• Acquire domain-specific or practical skills • •	• Situate skill in context of use • Guide or model skill in use • Set relevant and progressive tasks • Anticipate, elucidate and address learner difficulties	• 1. Plan • Decide intended outcomes • Decide criteria for success • Break down skills into component (progressive) units •	• • • • • • • For each component unit • 2. Prepare • Watch, read, listen,	• • • • • • • • → Keyword search of subject-specific resources

	• Give continuous feedback • Assess outcomes	• For each component unit: • 2. Demonstrate AND/OR instruct • • • 3. Support • Model and guide actions • • • Provide feedback on actions • • Support reflection, refinement and (self)assessment of skills • • 4. Assess overall performance • Set task reflecting whole skill-set • Feed back on task performance	receive instruction • 3. Practice • Act: try, apply technique/ protocol, use instrument/tool, follow instruction • Experience: see, hear, feel, notice, receive feedback • Reflect: (self) assess, (self) evaluate, critique, refine skills • • 4. Perform whole skill-set • Assessed task (test, drill, practical, observation, criticism/evaluation/review) •	(e.g. video demonstrations) • • → Mapping table C: select tasks appropriate to domain and outcome • → Mapping table D: select available and appropriate tools/services • • • • • → Mapping table E: select assessed task and type of feedback •
• Acquire general cognitive or academic skills	• Situate skill in context of use • Design or choose setting (‘authentic’ or ‘supported’) • Guide or model skill in use • Set relevant and progressive tasks • Anticipate, elucidate and address learner difficulties • Give continuous feedback • Assess outcomes	• 1. Plan • Decide intended outcomes • Decide criteria for success • Consider appropriate context and content for practice of skill • • 2. Demonstrate AND/OR instruct • Provide examples or model skill in context of use • • 3. Support	• • • • • • • 2. Prepare • Watch, read, listen, receive instruction • • 3. Practice • Act: try, apply technique/ protocol, follow instruction • Reflect: (self) assess, (self) evaluate, critique,	• • • • • • • → Keyword search of subject-specific resources (e.g. case studies, key skills resources) • • → Mapping table C: select tasks appropriate to domain and outcome • → Mapping table D:

		• Model and guide actions • Provide feedback on actions • Support reflection, refinement and (self)assessment of skills • • 4. Assess overall performance • Set task reflecting whole skill-set • Feed back on task performance	refine skills • • 4. Perform skill in context • Assessed task (test, portfolio, continuous assessment, criticism/evaluation/review) •	select available and appropriate tools/services • • • • → Mapping table E: select assessed task and type of feedback •
• Acquire social and communication skills •	• Establish a safe context • Provide structure to the social process • Negotiate clear outcomes of process • Model and guide social process • Give continuous feedback • Progressively give control of social process to learners • Assess outcomes	• 1. Plan • Negotiate intended outcomes • Negotiate criteria for success • Provide appropriate context and content for practice of skill • Determine structure of social or communication process • • 2. Support social and communication process • Suggest appropriate content resources • Facilitate and model process • Feed back on learner actions • Remediate problems and difficulties • • 3. Support reflection • Support reflection,	• 1. Plan • Negotiate intended outcomes • Negotiate criteria for success • • • • • • 2. Practice • Discuss = communicate OR collaborate OR debate, (depending on learning outcomes) • • • • • 3. Reflect • assess, analyse, interpret, draw conclusions •	• • • • → Keyword search of subject-specific resources (e.g. case studies, key debates and issues) • • • • → Mapping table C: select tasks appropriate to domain and outcome • → Mapping table D: select available and appropriate tools/services • • • • • • • •

		refinement and (self)assessment of skills • 4. Assess overall performance • Feed back on overall task performance	• 4. Receive feedback • Assessed task (observation, self-report, process capture, criticism/evaluation/review)	• → Mapping table E: select assessed task and type of feedback
• Develop own practice • Practice may be intellectual, professional, practical or creative	• Enable learner's participation in community of practice • Provide mentorship • Articulate and model practice • Support learner's developing relationships with other members of community • Help learner articulate own goals, needs, strengths and values • Support learner's critical reflection	• 1. Plan • Negotiate project and intended outcomes • Negotiate criteria for success • 2. Support practice • Feedback on learner's practice • Articulate and model practice • Provide access to further resources, examples and practitioners • 3. Support reflection • Support reflection, refinement and (self)assessment of skills • 4. Assess overall performance • Set task as agreed • Feed back on task performance	• 1. Plan • Negotiate project and intended outcomes • Negotiate criteria for success • 2. Practice • (Depending on area of professional, intellectual or creative practice) • 3. Reflect • assess, analyse, interpret, draw conclusions • 4. Receive feedback • Assessed task (observation, self-report, portfolio, reflective log, process capture, criticism/evaluation/review)	• → Mapping table C: select tasks appropriate to domain and outcome • → Mapping table D: select available and appropriate tools/services • → Mapping table E: select assessed task and type of feedback

8.3 Appendix 3: Outcomes of activity on information requirements for sharing and reuse.

(See section 3.2 for details of activity)

8.3.1 Mod4L: Pedagogy Experts Meeting 26/10/06

Group 1:

Browsing Applications of learning Activity Purpose Settings Content domain level	Choosing Prior learning -> Prior experience of use -> Impact on learning -> level of granulation Support required available Resources required Degree to which embedded in curriculum etc Context of use->ability, level, age, special circumstances Peer rating IPR
Developing Interdisciplinarity thesaurus links to other objects Possible pathways to other plans etc	Evaluating/Feedback Feedback to repository Structuring evaluation

Group 2:

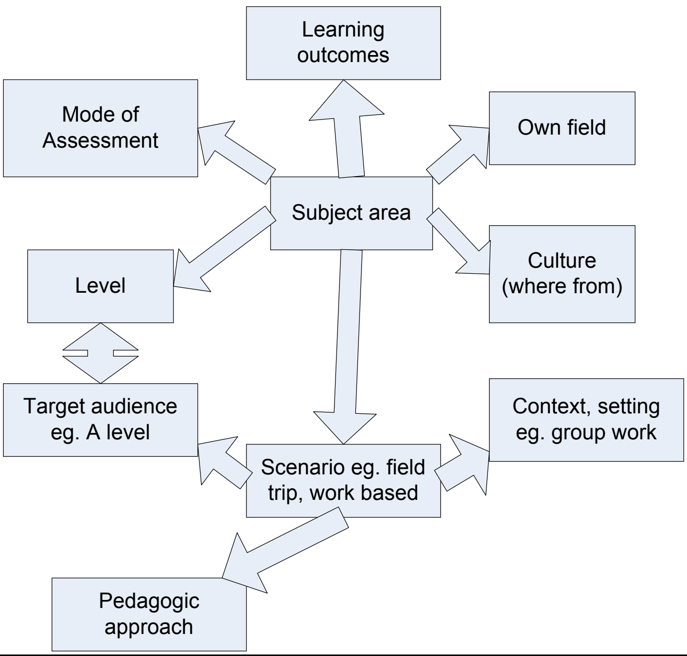
Browsing Topic/domain 1. Type of process, the “learning design”…but how to get this Level Tool – what can I use a wiki for? Type of learning experience/model of learning Author or institution Context (for designers, for med students)	Choosing Student/teacher reflection Overview/brief summary Match with my scenario Clarity/comprehensibility 1. Good description – see other 1.
Developing Light bulbs 1. good description to understand how it worked in one context Ability to “copy and paste” useful bits	Implementing “content package” IMS Learning Design (not sure I really mean this) [picture of a wrapped present]

Group 3:

Browsing Subject Level within context Teaching approach	Choose (a refining of browsing results) Author Peer review grade

Context Author Peer review grade By issue/problem (e.g. engaging) Media Teaching method e.g. webquest Student evaluation (if survey has been completed by learner	Level Subject Approach Innovative Technical – downloading/using Price/resourcing Copyright (protected or not) Easy to develop
Developing (does this mean repurposing) ?copyright Ease of adaptation - insert different files - word docs etc - change approach or method Ideas for alternatives (e.g. for technology failure)	

Group 4:

1. 	2. Best fit to 1. + Peer review +resource required (e.g. time)
3. How 1. does not fit + Resources missing +Critical aspects of review	4. Mapping to 1. Content e.g. learning objects Resource requirements (e.g. time) Teaching tips Firm up assessment Evaluation

Group 5.

Searching Learner characteristics (need a range of options) Learning outcomes Expert (person)	Choosing Expert (person) Credibility Performance evidence (?) Inspiration (did it inspire me in my own

Case studies Activity type Amazon-type services – (favourites, recommendations, profiling) – need high volume Content/ideas General field (topic/discipline) As you find 'stuff' you adjust what you are looking for – *so browsing is important* - serendipity	planning?)
Developing Using own expertise and experience Disagreeable What info is needed to help others? Time (e.g. length of session etc)	

Group 6

Search By type of learning outcome or learners needs addressed Content of learning outcome By situation/location/environment (physical and/or virtual) It can handle differentiation effectively By peer + peer review – YouTube browsing	Choose Quality of description and "brevity" Results & evidence of success of this design: student feedback; student achievement Peer review (DIGG) or Amazon Availability of support e.g. contact with originator
Develop References to Sources of additional information Relevant case case studies Research Student feedback from previous uses of this model Comments from practitioner/review Total time needed for study	Implement Pilot activities Evaluation criteria e.g. How long; reactions Cross refernce with other component designs

Group 7:

Browsing Discipline/level Institution (source) Approaches/activities Technology "Author" Group size IP Context	Choosing Student work Teacher reflection Case studies (good/bad practice) Barriers/enablers Infrastructure needed Activities Teaching approach Time + effort to implement "reputation" (endorsements) Aims & outcomes
Developing Mixed ability/differentiation Acessibility	Implementing Timing Venue connectivity

Examples of use Avoiding typical pitfalls/tips Infrastructure needed Barriers + enablers Reflective analysis Assessment criteria Aims + outcomes	Indication of equipment, aids, resources needed Ideal group size Outcomes Back-up plan Staff/student time + effort Sequence of activities Self evaluation

Group 8:

Browsing (Personal) aim [user preferences] = filters Level Subject Activity Learning outcomes Technology Assessment Review/popularity e.g. Amazon *** rating	Choosing Subject Activity Level Learning outcomes Student feedback – anecdotal - experiential (informal) Student feedback/response – outcomes reflected as case study/improved grades (formal)
Edit Student feedback Staff reflection Class size Position in course (beginning of year, revision exercise etc)	

Group 9:

Browse/search Number of students Subject Level Learning styles preference Size of UOL session/module Teaching approach Activity	Choosing Structure Content material Timings Sample work Resources
Edit, adapt, develop Teaching approach/structure of session Can change to be subject specific Resources	Implement Appropriate structure Content Probably would always want to change (individual) Learning outcomes Level Timing

Group 10:

1. Selecting/searching resources/lesson plan Peer/quality rated resources How many times it has been used Cost-benefit analysis	2. How do you evaluate selected resources e.g. what criteria Peer/quality criteria Cost considerations

Subject specific info/resources Transferable info/resources Develop <u>own</u> lesson plan (not shared)	Matching le? To quality Teacher reflections/views Collaborative evaluation of resources Type of assessment (e.g. diagnostic, formative, summative) Learning outcomes/objectives
3. What facilitates usage of selected resources Accessibility Availability Subjective view Integration with course Alignment Teachers tips/views Learner feedback Support needed (e.g. technical, pedagogical, admin)	

8.3.2 Mod4L November workshop

Group A:

Browsing/Searching: Lesson type – -online -blended -traditional Subject -specific Level, e.g. SCQF [Scottish Credit and Qualifications Framework] Author or publisher (also choosing) Student experience – background -previous courses etc Easy to read and understand Time constraints Older/newer? Is newer always best? Learning & teaching should not be marginalised by technology, iel. Learning centred <u>not</u> technology centred	Choosing Specific activities Criteria -best match -innovative -different => implementing Relevance to -aims/objectives -student activities Author or publisher Popularity of resource -ranking? Adaptability -options/tools that may be selected/deselected Learning outcomes Learning-centred not technology-centred Date of creation vs. popularity Feedback & comment from previous users Understandable, readable Time constraints
Editing, adapting, developing Teaching methods -seminars -BL etc	Implementing Tutor notes or support for new approach (from LD)

Numbers of students Incorporating new technologies If resources available -how adaptable -accessible Technical support, e.g. putting in RSS feed Feedback from students Time constraints Student performance -examples of work -performance statistics Easy to read and understand	Current status of resources, e.g. -WebCT version -lab equipment availability , etc Time scales Short 'fat' modules doesn't allow sufficient flexibility Technical support Explanation to students about learning design Flexibility Room/scope for students to shoot off on tangents and learn from this experience Time constraints

Group B:

Browsing, searching Subject Learning outcome Accessibility Tupe of student (prisoners) What the student needs Pedagogical approach	Choosing Quality (reputation) Delivery mode? Size of group Independence of learner when using What the student needs Time/duration Institutional climate Adaptability of pace Rights Suitability for assessment Culture/language Quality of representation Variety of approach/complements existing design Experience
Editing, adapting, developing Accessibility What the student needs Rights	Implementing What the student needs Cost Staff Development (skills)

Student feedback (response) Technical skill Brand politics Format Size of group Time	Assessment options Suggested remedial activity Time Physical environment RA£ requirements Learning environment Technical support and resources Size of group