The role of 'mediating forms of representation' in Learning Design

Gráinne Conole
University of Southampton
g.c.conole@soton.ac.uk

ABSTRACT
There are a plethora of learning theories which can use to guide the development of learning activities. In addition there are now a rich variety of ICT tools which can potentially be used in innovative ways to support the implementation of these learning activities. Despite this the actual range of learning activities which demonstrate a variety of pedagogical approaches and innovative use of ICT tools is limited. Practitioners lack the necessary skills to make informed choices and are confused by the plethora of choices. This paper defines and describes the range of mediating artefacts (or mediating forms of representation) which are increasingly being used by practitioners to make more informed judgements in designing learning activities. It will consider how these mediating artefacts facilitate decision making.

Keywords
Learning activities, mediating artefacts, toolkits, pedagogical theory, information and communication technologies

INTRODUCTION
The multitude of Information and Communication Technology (ICT) tools now available provides new opportunities to enhance learning but also complicates the situation by increasing the set of factors which practitioners need to take into account in making informed decisions about creating learning activities. While it is clear that technologies are having an increasing impact on institutions and practice (Conole, in press), it is equally apparent that their potential for enabling new styles of learning is not yet being realised (Conole and Fill, 2005; Bailey et al, 2006). Furthermore practitioners are confused by the plethora of learning theories and unclear about how to use them to create pedagogically more effective learning activities. Boud et al. (1993: 9) argues that 'the job of the teacher is to create imaginative ideas that make the learning engaging and meet the needs of learners', going on to state that 'the teacher creates an event which the learner experiences and may learn from.' Clearly technologies offer new opportunities to enhance the learning experience, but as of yet these opportunities are not being realised.

An inevitable characteristic of technologies is that they are constantly changing and evolving; new technologies are developed and the use of existing technologies evolves over time. Giddens (200) argues that we live in an unpredictable constantly changing world of globalisation with the increasing impact of technologies which results in intended consequences. This links to Beck's notion of a risk society and in particular the notion of 'manufactured risks' (Beck, 1992). Becks (1992), Giddens (2000), Castells (1996) and others, suggest that nothing is certain in late modernity and that we live in an increasingly culturally rich and complex society with changing norms and values. The impact of ICT across all aspects of our lives is one of the key features of this, and we are only just beginning to understand some of the ways in which technologies are changing our practice. For example, as Giddens notes (2000) 'instantaneous electronic communication isn't just a way in which news or information is conveyed more quickly. Its existence alters the very texture of our lives'.

Conole and Dyke (2004) have applied Gibson's (1997) concept of affordances to the use of ICT in teaching and learning, considering whether 'affordances (Salomon, 1993:51) can be used to facilitate particular approaches to educational practice', where 'Affordance' refers to the perceived and actual properties of a thing, primarily those functional properties that determine just how something could be used (Salomon, 1993:51). We proposed that 'a clearer articulation of these affordances would enable us to understand how these technologies can be most effectively used to support learning and teaching.' The ten 'affordances' we identified characterise 'those functional properties that determine just how the [technology] could possibly be used' (Salomon 1993); accessibility (i.e. immediate access to information), speed of change, diversity, communication and collaboration, reflection, multimodality, risk, immediacy, monopolization, and surveillance. The paper

describes both the positive and negative impacts of these affordances and considers how an understanding of these affordances might facilitate more effective approaches to e-learning. Articulation of the affordances of technologies highlights the potential of technologies, but also further demonstrates the complexity of effective use of technologies to support learning

Coupled with gap between the potential and actual use of technologies is a failure to apply effectively the range of learning theories which have emerged in recent years; in particular those centred around more socio-cultural and constructivist perspectives which emphasise learning by doing and collaboration. Therefore although there is now a wealth of knowledge about what makes for good and effective learning, there is still a predominance of didactic/behaviourist applications in e-learning, with a focus on transmission of knowledge.

While this second failure is not necessarily dependent on the first – it is quite possible to employ constructivist methods in a traditional face-to-face situation for example or to adapt a Virtual Learning Environment which is designed to promote a transmission mode of learning to foster more socially orientated learning - clearly it makes the task of creating pedagogically innovative learning activities which promote a range of theoretical perspectives more difficult. This suggests that more is needed in terms of mechanisms for supporting the creation of such effective learning activities and bridging the gap between the potential and actual practice.

LEARNING OBJECTS AND ACTIVITIES

Before moving on to discuss the concept of mediating artefacts which can facilitate the creation of better learning activities, it is worth reviewing recent thinking in e-learning design and development. Partly driven by the tantalising promise of the potential reuse and repurposing of learning materials (Littlejohn, 2003; Littlejohn, 2004), a considerable body of research has accumulated on the development of two key concepts in relation to this: learning objects and learning design.

From the mid-1990s onwards, online resources have often been referred to as 'learning objects'. However this concept is hotly contested with definitions ranging from a restricting view of learning objects as small digital resources through to whole units of learning with associated learning objectives and assessment. Koper and Olivier (2004) argue that e-learning specifications (such as the IEEE LOM) consider learning purely in terms of a process of consumption of content and go on to state that in reality current educational practice is more complex and advanced than this and that underpinning specifications for learning design should reflect this. Polsani (2003), suggesting that there are now "as many definitions of learning objects as there are users". Wiley's definition of a learning object is particularly popular, he suggests that learning objects are "any digital resource that can be reused to support learning" (2000) or that it is 'an independent and self-standing unit of learning content that is predisposed to reuse in multiple instructional contexts'. He asserts the importance of '*learning intention'* as both the framework and interface for a learning object. In terms of repurposability, he declared that development of a learning object must be separate from its implementation, in order not to 'favor one or other instructional methodology'.

However, learning occurs within a context and is influenced by a set of inter-related factors. Biggs (1999) describes good pedagogical design as ensuring that there are no inconsistencies between curriculum, teaching methods, environment and assessment. Learning activities occur within a particular context (in terms of the environment within which the activity occurs, the pedagogical approaches adopted and the institutional procedures and constraints), and are designed to meet a set of specified learning outcomes and assessment criteria through a series of tasks using a set of tools and resources. Creating the most effective conditions for learning therefore requires an understanding of each of these factors and their relationship to each other. The multitude of ICT tools now available provides new opportunities to enhance learning but also complicates the situation by increasing the set of factors which need to be taken into account.

Therefore, because learning is complex and occurs within a context, there has been considerable criticism about focusing the design of learning at the resource level. As Mayes and Fowler (1999) pointed out, one problem in focusing on learning objects is that teachers tend to plan e-learning around 'instructivist' learning models, which focus on single learners accessing content. Thus, it does not help bridge the gap between current pedagogical theory and implementation. Recent developments in technology allow us to go beyond simple repurposing of resources to support a wider range of pedagogical approaches, and in particular social-constructivist learning processes (Britain 2004; Mayes and De Freitas 2004). Interoperable, networked technologies have the potential to support students' collaborative activities, allowing them to source, create, adapt, integrate and store resources in a variety of formats. These new possibilities and the affordances of ICT tools means that it is becoming easier to use technology to support social-constructivist methods of learning, such as collaborative learning through learning communities (Koper 2004). These learning methods focus on the *process* of learning and on the learning activities students carry out in order to gain knowledge of concepts.

Beetham has described a learning activity as:

> *an interaction between a learner or learners and an environment (optionally including content resources, tools and instruments, computer systems and services, 'real world' events and objects) that is carried out in response to a task with an intended learning outcome* (Beetham 2004)

Conole et al (2005) suggest that examples of learning activities can vary from simple tasks such as students reading texts, participation in asynchronous discussions, undertaking quizzes, or tutorial exercises (Crook and Barrowcliff, 2003) through to more complete examples such as situated learning, simulations (Oblinger 2004), role-plays (Bell, 2001; (Salmon 2003), concept-mapping (Lee and Nelson, 2005; Nicol et al, 2005) or case-based scenarios.

To create or undertake learning activities practitioners therefore have to make complex decisions about which tools and theories to use. The JISC/NSF-funded DialogPlus project has developed an online toolkit which guides practitioners through the process of developing pedagogically informed learning activities (Conole and Fill, 2005; Bailey et al, 2006). The toolkit is underpinned by a taxonomy that attempts to consider all aspects and factors involved in developing a learning activity, from the pedagogical context in which the activity occurs through to the nature and types of tasks undertaken by the learner.

Learning activities are achieved through completion of a series of *tasks* in order to achieve intended *learning outcomes*. We have defined the components which constitute a learning activity as:

- The *context* within which the activity occurs; this includes the subject, level of difficulty, the intended learning outcomes and the environment within which the activity takes place. Learning outcomes are mapped to Bloom's taxonomy of learning outcomes and grouped into three types: cognitive, affective and psychomotor and are what the learners should know, or be able to do, after completing a learning activity; for example they might be required to be able to: understand, demonstrate, design, produce or appraise.
- The *pedagogy* (learning and teaching approaches) adopted. These are grouped according to Mayes and de Frietas' (2004) three categories – associative, cognitive and situative.
- The *tasks* undertaken, which specifies the type of task, the (teaching) techniques used to support the task, any associated tools and resources, the interaction and roles of those involved and the assessments associated with the learning activity.

LEARNING THEORIES AND TOOLS TO SUPPORT LEARNING

The nature of learning and what characterises it has been the subject of intense research for centuries stretching back as far as Aristotle and Plato. As a result various schools of thought have arisen which emphasise particular aspects of learning – such as learning by doing, through cognition, in authentic settings or through reflection. A number of models have tried to encapsulate these different aspects such as Dyke, who proposes a model based on 'learning with others', 'reflection', 'theory' and 'practice'), whilst Conole and Dyke (2004) have suggested mapping learning models along three axes: individual – social; reflection – non-reflection; information – experience. See also Beetham (2004), Conole et al (2004), Mayes and de Freitas (2004), Ravenscroft (2002), Thorpe (2002), for reviews on learning theories and their use in e-learning. Mayes and de Freitas' grouping is particularly useful; they group learning theories into three categories: *associative* (learning as activity), *cognitive* (learning through understanding) and *situative* (learning as social practice). They suggest that theories of learning provide 'empirically-based accounts of the variables which influence the learning process, and explanations of the ways in which that influence occurs'. This definition seems to encompass the exemplars Beetham has given of what she calls 'theoretical models', i.e. the meaning usually assigned to 'model' in the research community.

Our understanding of the use of ICT tools in education is much less mature. The Web and associated tools have now been used in education for just over a decade and the ways in which they are impacting on practice is only beginning to be researched (Conole, in press). What is clear however is that ICT tools are having a dramatic and fundamental impact on practice; both positive and negative. The best example of the increased use and importance of ICT is the now ubiquitous use of the computer as a work tool and the replacement of many traditional work modes of communication, such as memos, with email. Technologies offer practitioners and students new ways of doing tasks (faster, easier, more comprehensively) but also can have associated drawbacks; for example although the Web provides access to vast quantities of materials there are increasingly real issues about information overload, access, quality control and authenticity of materials (Conole and Dyke,

2004). Similarly, tools for communication offer opportunities for new forms of dialogue and collaboration but require new forms of literacy and skills. Table three provides a summary of tools, their characteristics and impact on practice.

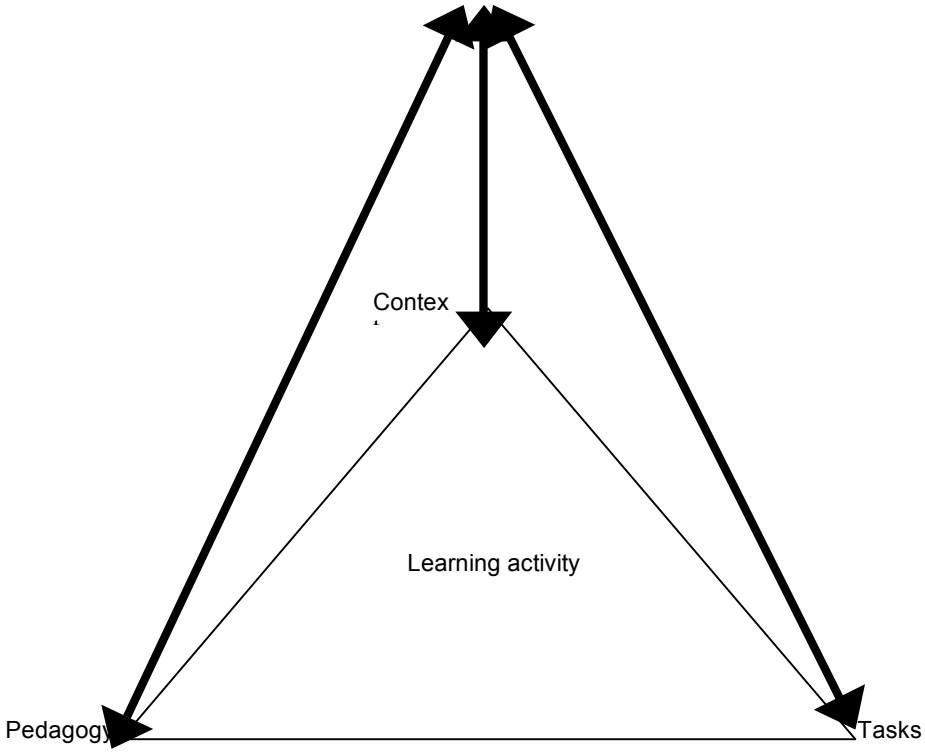
Therefore it is evident that although a lot is known about the theory underpinning learning and there is clearly enormous potential in terms of how ICT can be used to facilitate instantiation of these theoretical perspectives; in practice this potential has not yet being realised.

MEDIATING ARTEFACTS

Given the complexity discussed earlier, practitioners are faced with a bewildering array of choice to undertaken specific learning and teaching actions. For example, a practitioner could choose to use a discussion board coupled with a chat tool to promote dialogic learning or a shared blog space to promote constructivist learning, but which tools and theories are most appropriate for a particular situation? Practitioners are confused by the range of tools and theories and need support in deciding which might be appropriate for a particular learning activity. Similarly students are often confused by the wealth of materials and resources provided to supplement their courses, struggle to navigate around Virtual Learning Environments or are unable to make maximum use of ICT tools (such as discussion boards or chat facilities). Furthermore research demonstrates that students find it difficult to adopt more student-centred pedagogical approaches (such as constructivism or group-based collaboration) unless clear guidance and support is provided.

These issues are further exacerbated by the fact that these choices need to be made within a constantly changing context. To facilitate practitioners in making informed choices they need support and guidance. Vygotsky's concept of Zone of Proximal Development (ZPD) centres on the notion that there is a gap between a learners' current state of learning and their potential and that part of the process of teaching is about providing forms of guidance or scaffolding to bridge this gap. This paper builds on this notion by focusing on the concept of Mediating Artefacts (MAs) which represents these scaffolds, considering this in terms of scaffolds to support both teachers and students in making informed decisions. For practitioners the focus is on MA to guide them in creating pedagogically informed learning activities, whereas for the students it is to guide them in undertaking particular learning activities to achieve specific learning outcomes.

For practitioners to create pedagogically informed learning activities or for students to undertake learning activities which make effective use of tools and theories, this paper argues that practitioners need mediating artefacts which support and guide decision making. Figure one shows the relationship between mediating artefacts and the three components of learning activities outlined earlier. In creating or using learning activities practitioners need to make decisions about the context of the learning activity, the underlying teaching and learning approaches or pedagogies used and the nature and types of tasks associated with the learning activity. Mediating artefacts can provide guidance for each of these aspects, some may focus on providing support on implementing a particular learning theory, others may provide guidance on the context of the activity, whilst others might provide practical solutions on how to create tasks and make choices on the use of associated tools and resources.



Mediating artefacts help practitioners to make informed decisions and choices in order to undertake specific teaching and learning activities. By using this concept of MAs and grounding this in relevant socio-cultural literature it is possible to begin to identify which MAs are appropriate for particular users in particular circumstances.

Different mediating artefacts provide support and guidance on decision making about: the context of a learning activity, the choice of pedagogy, the creation of associated learner tasks or any combination of these. Table four lists some examples of typical mediating artefacts which are used to support learning and teaching. Within the range of artefacts that mediate facilitation there is a hierarchy from more abstract and conceptual moving through more contextually situated which finally result in specific instantiations of a particular learning activity. One of the benefits of articulating these mediating artefacts is that it highlights their role in terms of providing a concrete mechanism for reuse and repurposes of learning activities.

Narratives and case studies provide rich contextually located MAs which are valuable in that they describe the details of a particular pedagogical intervention. The drawback is that precisely because they are so contextually located they may be difficult to adapt or repurpose. Practitioners also use a range of dialogic MAs, which enable flexibiliy as these provide an opportunity to clarify and discuss in further detail. Perhaps the most important of this are MAs based on peer dialogue – such as asking advice from a fellow teacher about how they have gone about setting up a teaching session. Conferences, workshops, staff development events and online networks and mailing lists provide more extended forms of peer dialogue and networked expertise. These are increasingly popular, particular since the establishment of professional bodies such as SEDA and ALT, as well as the HE Academy and its subject centre network.

Lesson plans provide a means of formalising learning activities and a framework for teachers to reflect in a deeper and more creative way about how they design and structure activities for different students and help achieve constructive alignment between theory and practice (Littlejohn 2003; Conole and Fill 2005; Fowler and Mayes 2004). They are particularly useful in helping tutors to plan *blended learning* (i.e. the integration of technology supported methods with face-to-face teaching), since they can be used to reflect explicitly upon different educational approaches. These are, however, less likely to influence the Higher Education sector, since HE curricula are frequently non-standardised; though increasing emphasis on documentation and quality assurance within the sector may lead to their wider use (Littlejohn and McGill 2004).

Other examples of MA include demonstrations, tips and tricks, guidelines and answer gardens. All provide either some form of abstraction of good practice or access to other peer experts who can share their experience

Models and patterns provide more abstract forms of representation. Simplistically, a model is an abstract representation which helps us understand something we cannot see or experience directly. Beetham considers a model to be 'a representation with a purpose' with an intended user, and distinguishes five usages of the word. 'practice models or approach', 'theoretical models', 'technical models', 'models for organisational change', and students' models. 'Theoretical models' may exist at various levels of abstraction and provide 'a way of explaining or exploring what happens in the learning context', are rooted in research evidence and are explicit about their theoretical perspective. 'Technical models' provide a way of structuring representations, for example in a given code (e.g. XML) or conforming to a given specification or standard (e.g. IMS LOM).

Kolb's learning cycle is probably the best known experiential model. Building on the work of Dewey, Lewin and others, it presents an action-based or 'learning by doing' approach through a four-stage cycle (experience, reflection, abstraction and experimentation). Recently, Cowan has extended Kolb's' learning cycle by considering explicitly how to plan interactive activities to support each of the four stages (Cowan 2002).

Wenger's theory of communities of practice (Wenger 1998) considers the ways in which communities of practice are formed and developed. He sees four main aspects: learning as community; learning as identity; learning as meaning; learning as practice. This is very much an example of a socially situated model of learning where learning is seen as social participation.

A specific e-learning model that describes the stages of increasing competence in participating in the community is Salmon's five-stage framework (2003) for supporting effective e-moderating in discussion forums, which emphasises the dialogic aspects of socially situated theoretical perspectives. Her stages are: access and motivation; online socialisation; information exchange; knowledge construction; development. This model has been incredibly popular and has been taken up and applied extensively. In addition Salmon has reproduced a range of suggested e-activities to promote effective online communication.

However there has also been some critcism of the use of models. Because by their nature they are abstractions, partitioners may misunderstand how to effectively apply the model, by adopting a surface application of the model to their practice.

Most commercial software now comes with some form of in-built help system. In addition many also provide templates or how-to wizards to guide the user through a particular set of activities. As a consequence practice has shifted from a culture of reading the manual of instructions to a just-in-time culture based on immediate need. A wizard is a software tool that makes decisions on behalf of the user, based on solicited information and drawing on pre-defined templates. In most cases, the way in which these outputs are generated is hidden from the user. As a result, it is easy to use, but restrictive in terms of the type and variety of potential outputs or ways in which the user can interact with the tool.

Another type of guidance tool is exemplified by a tool for guiding practitioners through the process of learning design called LAMS (Learning Activity Management System). Tools are organised so that users can pick and mix different types of learning activities. Another category of support tool is toolkits, which are decision-making systems based on expert models, positioned between wizards and generic conceptual frameworks which can provide a theoretical overview of an area and hence be used as a point of reference for decision making. (Conole and Oliver, 2002; Oliver *et al.*, 2002). A toolkit provides a structured resource that can be used to plan, scope and cost an activity (examples include the development of an evaluation plan, choosing and integrating different types of media into teaching, or managing information). By providing increasingly detailed layers of information, the user can follow up relevant issues when and if such detail required. In addition, by providing a simple, logically organised structure toolkits help to reduce the time required to plan work of this type.

As described realier, the DialogPlus project has developed a specification for a learning activity design toolkit which aims to guide practitioners through the process of developing pedagogically effective learning activities and appropriate use of relevant tools and resources (Conole and Fill, 2005).

CONCLUSION

As this paper has shown mediating artefacts range from contextualised narratively rich representations (such as case studies) through to more abstract artefacts (such as models). This raises the question which mediating artefacts are appropriate in which circumstances for a particular user? This also raises other research questions

such as what is the relationship between a particular mediating artefact and the socio-cultural/historical context of the user.

The paper has focused on the use of the concept of mediating artefacts to describe the range of artefacts which can be used by practitioners to make more pedagogically informed choices about designing and undertaking learning activities. It has considered how this concept aligns with other theoretical perspectives in the literature and outlined a set of associated affordances of these mediating artefacts arguing that a better articulation of these affordances should help inform practitioners in making choices about which mediating artefacts are most appropriate for their particular needs.

Providing a definition of this type is useful in two respects. Firstly, it highlights the relationship between the informed choices practitioners need to make to create or undertake learning activities (about context, use of different learning theories, types of tasks and associated use of tools to support these tasks) and the ways in which mediating artefacts can facilitate this choice. Secondly, it foregrounds the range of mediating artefacts which are being used by practitioners, highlighting their different uses, as well as the way in which they are informed by history, context and culture. By having a better understanding of mediating artefacts and how they can be used, researchers and developers will be more likely to be able to develop and target mediating artefacts for specific purposes, which will in turn enable practitioners to design better more pedagogically effective learning activities.

Therefore there are several benefits of using MAs. Littlejohn (2003) has previously described the benefits of lesson plans, which are equally applicable across different types of MAs. Firstly, effective learning activities may be shared, thereby creating economies of scale (Littlejohn 2003). Secondly, examples of effective practice may be communicated to other teachers. This could aid practitioners in making informed decisions between comparable activities and approaches (Beetham, 2004). Thirdly, they can be used as a framework for planning for accessibility, since resources can be replaced by other materials that closely match learners' needs. Fourthly, MAs are effective means of communicating design requirements to developers.

Despite a well-established practice of teachers adopting and adapting pre-designed MAs, such as case studies, lesson plans, etc, there is no evidence of generic mediating artefacts being developed and shared without specific subject content (Beetham, 2004). This is partly because it is difficult to abstract an activity that can be reused across a range of subject disciplines (Britain, 2004).

Further research is needed to explore the nature and potential of these artefacts, by better understanding the range of mediating artefacts and their potential and affordances we may start to begin to see the real potential of ICT to support learning which the general hype in this area has for so long promised.

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