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Formalising the description of learning designs

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***Abstract**: This paper describes an activity being undertaken by researchers involved in the AUTC funded Project: Information and Communication Technologies and Their Role in Flexible Learning. The project is seeking to investigate and develop generic and reusable frameworks for the provision of technology-enhanced high quality learning experiences in higher education. To achieve this, the researchers have been exploring ways to formalise generic descriptions of some learning designs that foster knowledge construction and problem solving. This paper provides a summary of the work that has been undertaken and describes the generic descriptions that have been developed in this process.*

***Keywords**: learning designs, ICT-based learning, Web-based learning*

Introduction

There is growing awareness today of the value of learning environments in higher education that foster knowledge construction. This awareness has coincided with the development and increased uptake of information and communication technologies as supports for learning and increasingly we are seeing examples and instances of the learning settings based on constructivist principles (eg. Harper & Hedberg, 1997). These principles propose that learning is achieved by the active construction of knowledge supported by multiple perspectives within meaningful contexts. In constructivist theories, social interactions among learners are seen to play a critical role in the processes of learning and cognition (eg. Vygotsky, 1978).

In the past, the conventional process of teaching, and that of instructional design, has typically revolved around a teacher planning and leading students through a series of instructional sequences and events to achieve a desired learning outcome (eg. Gagné & Briggs,

1974). Typically these forms of teaching focus upon organised transmission of a body of knowledge followed by some forms of interaction with the material to consolidate the knowledge acquisition. Contemporary learning theory is based upon the notion that learning is an active process of constructing knowledge rather than acquiring knowledge and that instruction is the process by which this knowledge construction is supported rather than a process of knowledge transmission (Duffy & Cunningham, 1996).

Instructional design

In learning settings that support knowledge construction, the emphasis is placed on learning as a process of personal understanding and the development of meaning in ways which are active and interpretative. In this domain, learning is viewed as the construction of meaning rather than as the memorisation of facts (eg. Lebow, 1993; Jonassen & Reeves, 1996). Technology-based approaches to learning provide many opportunities for constructivist learning through their provision and support for resource-based, student-centred settings and by enabling learning to be related to context and to practice (eg. Berge, 1998; Barron, 1998). In contemporary learning, we use the concept of a learning environment to describe the setting in which learning takes place. A learning environment typically contains the learner and a space where the learner acts with tools and devices to collect and interpret information through a process of interaction with others (eg. Wilson, 1996). The concept of a learning environment is that of a flexible learning space and quite different to the instructional sequence which has previously characterised instructional design strategies.

The conventional art of instructional design has previously been very well defined and many guidelines and models have been developed to guide instructional designers in the process of developing instructional sequences (eg. Dick & Carey, 1990, Gagne, Briggs & Wager, 1991). Instructional design for learning settings that promote knowledge construction is a far more complex process. There is a distinct shortage of models and explicit frameworks for instructional designers. Jonassen (1994) argues that there cannot really be any firm models guiding the design of constructivist settings since knowledge construction is so context-specific. Lefoe (1998) argues that learning design theory today serves to provide principles and general concepts by which learning environments can be planned. The process is far less rigid and has fewer guidelines than previously and is a very difficult process for many.

Describing learning environments that support knowledge construction

Many writers have, however, attempted to provide guidance for the design of constructivist learning settings by articulating the underpinning characteristics. For example, Cunningham, Duffy & Knuth (1993) argue that constructivist learning environments are characterised by seven pedagogical goals in that constructivist learning settings are those which concurrently:

- provide experience in the knowledge construction process;
- provide experience in and appreciation for, multiple perspectives;
- embed learning in realistic and relevant contexts;
- encourage ownership and voice in the learning process;
- embed learning in social experience;
- encourage the use of multiple modes of representation; and
- encourage self-awareness in the knowledge construction process.

Lebow (1993) describes five underpinning principles that integrate the affective and cognitive domains of learning in ways that support constructivist principles of learning. These principles suggest the need for learning environments to:

- maintain a buffer between the learner and the potentially damaging effects of instructional practices;
- provide a context for learning that supports both autonomy and relatedness;
- embed the reasons for learning into the learning activity itself;
- support self-regulated learning by promoting skills and attitudes that enable the learner to assume increasing responsibility for the developmental restructuring process; and
- strengthen the learner's tendency to engage in intentional learning processes, especially by encouraging the strategic exploration of errors.

The descriptions that authors provide of the elements required for constructivist learning settings can help designers to understand the forms of learning activity which are required but often fail to provide adequate guidance for the actual learning designs that can encapsulate such principles in cohesive and supportive ways. For example, Hannafin, Hall, Land, and Hill (1994) suggest that appropriate forms of learning settings are open-ended and characterised by learner engagement in cognitively complex tasks involving such activities as problem solving, critical thinking, collaboration and self-regulation.

There is currently little empirical work that can guide the design of learning settings that support knowledge construction. Different authors and different projects have described a range of distinct forms of learning settings that have been designed to encourage learner activities that support knowledge construction. The following examples are presented.
Ip and Naidu (2001) outline a range of experienced-based pedagogical designs suitable for online learning. They argue that one characteristic feature of such experienced-based learning designs is the nature of the learning experience. They distinguish between first-person-experience-based designs and third-person-experienced-based designs. The distinction is based on whether the learning occurs through first-hand experience, for example in a simulation or role play setting, or from a third person information source through such means as resources and content forms.

Jonassen (2000) describes learning designs that support knowledge construction as problem-based learning settings and describes eleven problem-types in a form that suggests a continuum from problem solving based on the application of rules; activities based on incidents and events; through to solutions that require strategic planning and activity; and problem solutions based on learners' performances. Oliver (1999) and Oliver and Herrington (2001) have synthesised the range of learning designs by developing a framework that identifies and critical elements required in a learning design, particularly when ICT mediated. The critical elements comprise the content or resources learners interact with, the tasks or activities learners are required to perform, and the support mechanisms provided to assist learners to engage with the tasks and resources. This is illustrated in Figure 1.

A framework for describing learning designs

In our research associated with the AUTC Project: *Information and Communication Technologies and Their Role in Flexible Learning*, we have been exploring strategies by which the nature and scope of the forms of learning designs described above can be formalised. Having formal descriptions will provide the means to more easily guide the instructional design process and will also provide some means for institutions to provide supports and structures for teachers wishing to employ them.

As part of the project the researchers and other project members analysed a wide range of technology-based learning designs to identify its underpinning pedagogies. These designs were collated from a variety of sources including CAUT and CUTSD funded ICT-based

projects. The analysis of the learning designs was based on the identification of the three critical elements: learning tasks, learning resources and learning supports (Oliver, 1999). The analysis was conducted by examining the descriptions of all the learning design exemplars to determine emergent clusters. The work by Ip and Naidu (2001), which discusses a selection of experience-based pedagogical designs that stand to make the most of the opportunities afforded by information and communications technology, informed this process At the same time the various problem types described by Jonassen (2000) were used as a means to develop a framework by which learning designs might be classified and described.

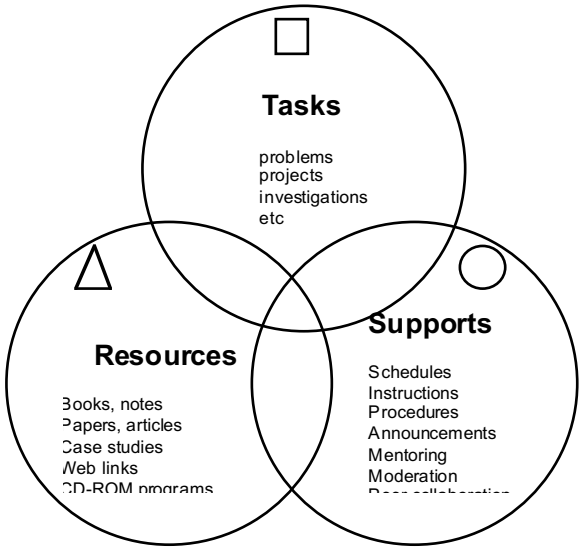

Figure 1: Elements of a learning design. Based on Oliver (1999) and Oliver & Herrington (2001)

Based on the project team's grounded analysis plus further exploration of the Jonassen (2000) problem types, there appear three discrete forms of learning design within the eleven. These discrete forms each encompass a number of the problem types and appear capable of being used to further categorise potential learning designs. The problems encompassed within Jonassen's descriptions are typically either of a rule-based, an incident-based, or a strategy-based form. Our inquiry suggests a fourth type of learning design, that of role-based and devised two additional problem types that are characteristic of this form. The four types of learning designs that emerge from this form of analysis and development are shown in Table 1. The learning designs are discrete and follow what might be seen as a continuum describing the scope of their complexity and open-ness. Table 1 provides descriptions of each learning activity focus and the forms of learning outcome that are associated with each.

Table 1: A framework for a learning design typology

Focus	Description	Outcomes	Examples	Jonassen Problem Types
Rule focus	Applying learned processes and rules to achieve an outcome. The learning task requires learners to apply standard procedures and rules in the solution.	A capacity to meaningfully and reflectively apply procedures and processes.	Solving a task which requires the selection and application of one or a set of principles to achieve the goal. Creating a report within a writing genre where the genre has standard structures and form.	Logical Problems Algorithmic problems Story Problems Rule-using problems

Focus	Description	Outcomes	Examples	Jonassen Problem Types
Incident focus	Starting from a critical incident or scenario learner argues a course of action (moving from incident to out-come or resolution) The learning activity is based around learners' exposure and participation in events or incidents of an authentic and real nature. The learning is based around activities that require learners to reflect and take decisions based on the actions and events.	Disambiguate scenario using an understanding of procedures, roles and the ability to apply knowledge and processes.	Read a scenario and identify what are the key issues, and how these influence what should be done.	Scenarios* Decision making Case study tasks
Strategy focus	Application of problem solving strategy with multiple options to achieve the outcome (for design problems the criteria might also include innovative application of ideas) Often the strategy options are generated as part of the solution.	A capacity to apply know-ledge in meaningful ways in real-life settings often with time and performance constraints.	Teaching in live class. Arguing points of law before court. Compose a fugue. Design a vehicle that flies.	Troubleshooting Diagnosis solution problems Strategic performance tasks Design tasks
Role focus	The learning is achieved through learners' participation as a player and participant in a setting that models a real world application. The position and perspective of the learner (the role they take on) assists in achieving an outcome for the dilemma (a focus on multiple perspectives assists in achieving the outcome) Learners apply judgements and make decisions based on understanding of the setting in real time scenarios based upon the particular perspective of the role they take to the learning task.	Understanding issues, processes and interactions of multi-variable situations with outcomes based on the multiple perspectives of roles taken.	Conduct negotiations for a peace resolution within the middle east based on each learner researching and taking a first person perspective on the role and negotiating from that perspective.	Dilemmas Social dilemmas*

Table 2: A framework for a learning design typology

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

The nature of the various learning designs described in Table 1 can be further demonstrated and exemplified by considering the forms of tasks, supports and learning resources that each would require in a learning setting (Oliver, 1999). Table 2 uses this strategy to further exemplify and distinguish the four types of learning design suggested by this process.

Describing learning designs in generic forms

In our project, we have a need to be able to articulate clearly the nature and scope of different forms of learning design in ways that will enable that design to be applied across a variety of settings and disciplines. We clearly have a need for some strategy by which the various learning designs can be described and variations and instances can be accommodated. To achieve this goal, we have proposed the use of a temporal sequencing strategy based on the three critical elements of learning environments proposed by Oliver (1999). In the following section, we propose a series of potential generic categorisations based on the four main forms of learning designs using a temporal representation describing the interactions of the tasks, resources and supports. It is our intention to work with the generic descriptions and to refine their elements and components through their application to the various forms of learning design that emerge from our investigations and inquiries.

1. Rule-based designs

Figure 2 shows a temporal sequence for the form of learning design we have designated rule-based. Rule-based designs are those that are primarily comprised of closed tasks whose completion requires the application of some form of rules, procedures or algorithms. In rule-based learning designs, the resources which learners use include the procedural and system descriptions needed for the application and the environment the necessary supports to enable learners to achieve success in their efforts. The learning is achieved through learners applying standard procedures and rules in developing a solution. For example, algorithmic approaches involve the application of given procedures and rules in defined ways to effect a solution. The tasks that are provided need to provide learners with opportunities to meaningfully and reflectively apply procedures and processes to specific closed, logical and bounded tasks.

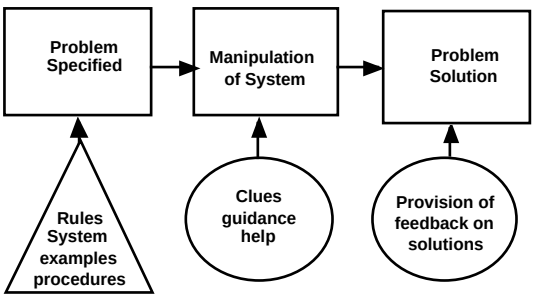

Figure 2: Temporal sequence describing a rule-based learning design

2. Incident-based learning designs

In an incident-based learning design, the learning activity is based around learners' exposure to, and participation in, events or incidents of an authentic and real nature. The learning is based around activities that require learners to reflect and take decisions about the actions and events. The temporal sequence shows learning based around a description of the incident, elaboration of that incident through reflection, a group or individual process to find a solution or to come to a decision, declaration of a solution or decision, and provision of feedback on solution or decision. Incident-based learning designs can be supported through learner collaboration and through opportunities to articulate and reflect on the learning provided by a teacher acting as a mentor. The learning is based around activities that require learners to

reflect and take decisions based on the incidents and events that are represented. The setting requires a range of resources to provide rich descriptions and information about the incident and event upon which the learning is based.

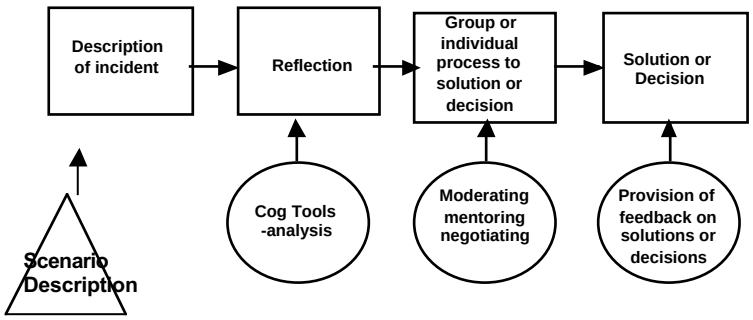

Figure 3: Temporal sequence describing an incident-based learning design

3. Strategy-based learning design

Strategy-based learning designs are characterised by such activities as complex and ill-defined tasks, decision-making tasks, some trouble shooting tasks, diagnosis solutions and strategic performance tasks. The temporal sequence shown in Figure 4 suggests a learning design where learners undertake a series of activities and at the same time interact with a variety of resources and learning supports. The process involves specification of the strategic problem, elaboration of that problem through reflection, a group or individual process to carry out the task, declaration of a solution or outcome from the tasks and reflection on the learning process.

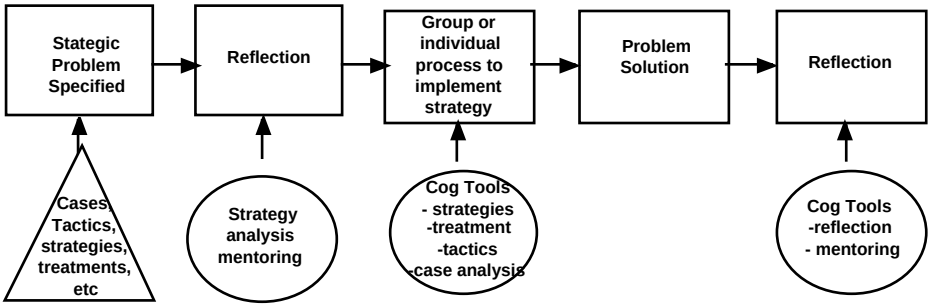

Figure 4: Temporal sequence describing a strategy-based learning design

In strategy-based learning designs, learning is based around tasks that require strategic planning and activity. The environment requires authentic resources that support multiple perspectives, provide such elaborations as expert judgements, and which also provide descriptions of theoretical underpinnings. Typically learners are also provided with sample tasks and solutions, cases, tactics, strategies and treatments. Support is provided through a teacher acting as a coach and facilitator, and often through collaborative learning tasks involving such strategies as peer assessments and the provision of meaningful opportunities and contexts for articulation and reflection.

4. Role-based learning design

In role-based learning, learners acquire skills, knowledge and understanding through the assumption of roles within real-life settings. The design typically involves some purposeful and directed preparation and role-playing in scenarios that have been developed to provide the forms of learning opportunities sought in the objectives. The temporal sequence shown in Figure 4 involves the declaration of learner role, on-line dialogue to clarify this role, presentation of a dilemma to resolve, on-line dialogue to resolve the dilemma within the

perspective of a role, a possible negotiated resolution to the dilemma and reflection on the process.

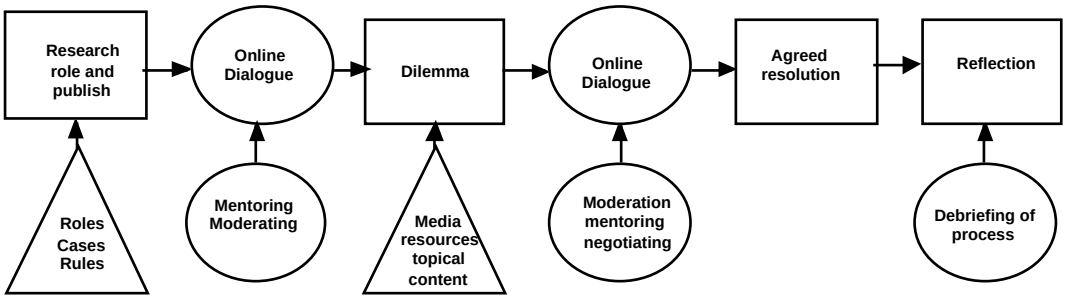

Figure 5: Temporal sequence describing a role-based learning design

In role-based settings, learning is achieved through learners' participation as a player and participant in a setting, which models a real world application. Learners apply judgements and make decisions based on understanding of the setting in real time scenarios. The settings require an array of resources to support the learners' role including procedural descriptions, role definitions, resources to define and guide roles, scenarios, topical content and cases. Typically the role of the teacher is that of a moderator and mentor, who creates opportunities for the learners to articulate and reflect on their learning experiences.

Summary and conclusions

The project is now at a point where we are attempting to use these various forms of generic learning design to extend the range of problem-types described by Jonassen (2000) and to create linkages to some additional problem designs which have arisen from the grounded review of projects. At the same time the project team is using the generic descriptions to describe examples of best practice in technology-based learning and to explore the effective pedagogies underpinning these examples.

Critical to the success of this project is the collaboration with an acknowledgement of the designers of the learning designs that the project team deem suitable for redevelopment. The project team wishes to involve designers in the redevelopment phase and any derivative products generated will appropriately acknowledge their innovative designs. As the project progresses, it aims to document in very detailed ways, the forms of the learning designs and to provide templates and frameworks that will enable teachers wishing to implement such designs to have some firm guidance and support in the process.

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Note: The project has developed a Web site that is being used to inform people of the progress and ultimately to provide access to the resources and materials that are developed. (http://www.learningdesigns.uow.edu.au)